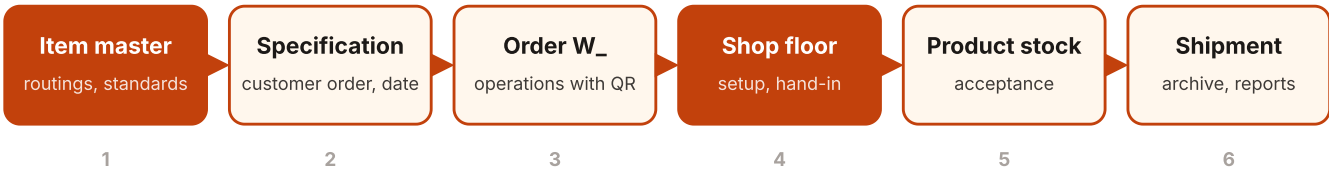
MARSHRUT MES

How to work from A to Z

User manual: the workflow for every role from the item master to shipment, production rules and lean manufacturing on the Toyota system — and how to do it in the software



Software version 3.5, build 823 · October 2026 · Screenshots taken on demo data (the demo data is in Russian)

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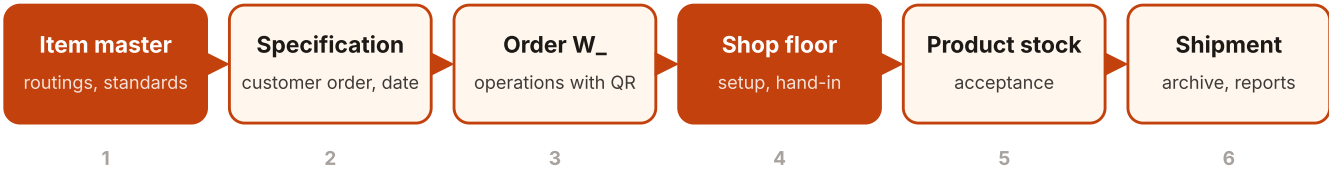
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01 EVERYONE

The core logic



Everything in the software rests on one chain: **what we make → for whom and by when → who made it and when → where it went**. Each next step takes its data from the previous one, so the order matters: without a routing there are no operations in an order, without operations there are no tasks on work centers, without closed operations there are no receipts in the warehouse.

1. **Item master** — what we make: parts and assemblies, their routings (operations, work centers, time standards), materials, files.
2. **Specification** — a customer order for a product: structure and ship date. Production orders with start dates calculated from lead times are created from it.
3. **Order (W_...)** — a production assignment for a part or assembly in the required quantity. On creation, operations (tasks) with QR codes are generated automatically from the routing.
4. **Shop floor** — operators on their shift take operations into work, do the setup, hand in parts with the scanner or a button. The foreman sees everything on the board and in the work center queues.
5. **Product warehouse** — when all operations of a part are closed, it arrives at the warehouse by itself; the storekeeper accepts it and kits assemblies and shipments.
6. **Shipment and archive** — a completed order is shipped and goes to the archive. Reports and analytics are built from what was actually recorded on the shop floor.

There is one rule: **record events in the software when they happen**, not after the fact. Then due dates, the board, time standards control and cost tell the truth.

02 EVERYONE

Roles: who is responsible for what

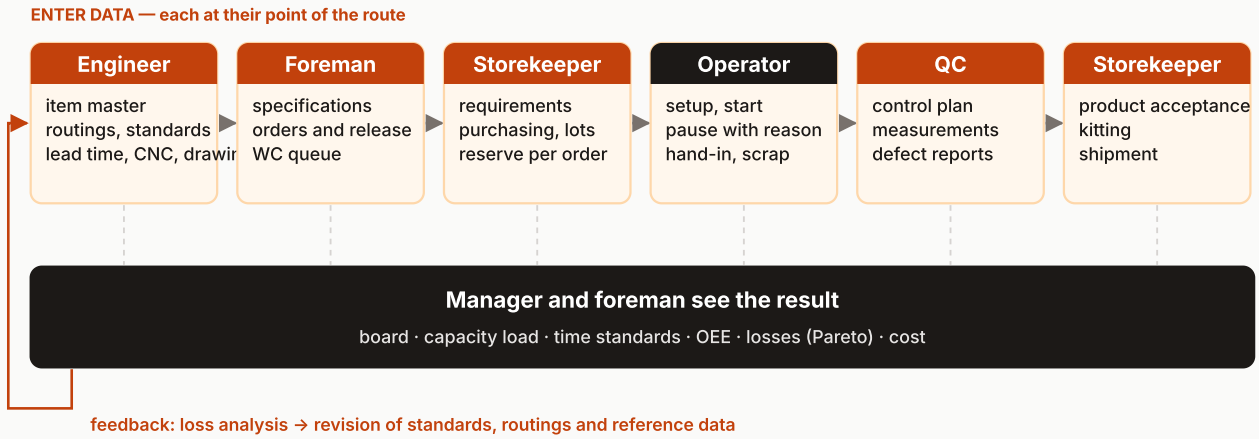


Diagram 1. Who enters data and who uses it: each role is responsible for its point of the route

Everyone works under their own account: the menu and buttons depend on the role, and the logs show who did what. Role permissions are changed in Admin panel → “Roles and permissions”.

Role	What they do in the software	Main sections
Administrator	Configures the system, creates people and work centers, watches backups and security	Admin panel
Foreman / production manager	Creates and starts orders, manages WC queues, clears “Problem”, edits order operations, confirms actual time	Board, Orders, Specifications, Work centers, Capacity
Process engineer / senior process engineer	Maintains the item master and routings, uploads drawings and CNC programs, closes tech prep requests; the senior one assigns people	Item master, Tech prep
Storekeeper	Accepts products, kits, issues material and tools, posts purchase receipts	Warehouse
QC	Maintains the control plan, enters and checks measurements	Quality, Traceability
Maintenance technician	Takes repair requests, keeps the PM schedule	Maintenance
Operator	Opens a shift, takes operations, hands in parts, pauses, reports breakdowns and problems	Board → “My tasks”, Scanner
Viewer (management)	Only views: board, reports, weekly summary	Board, Reports

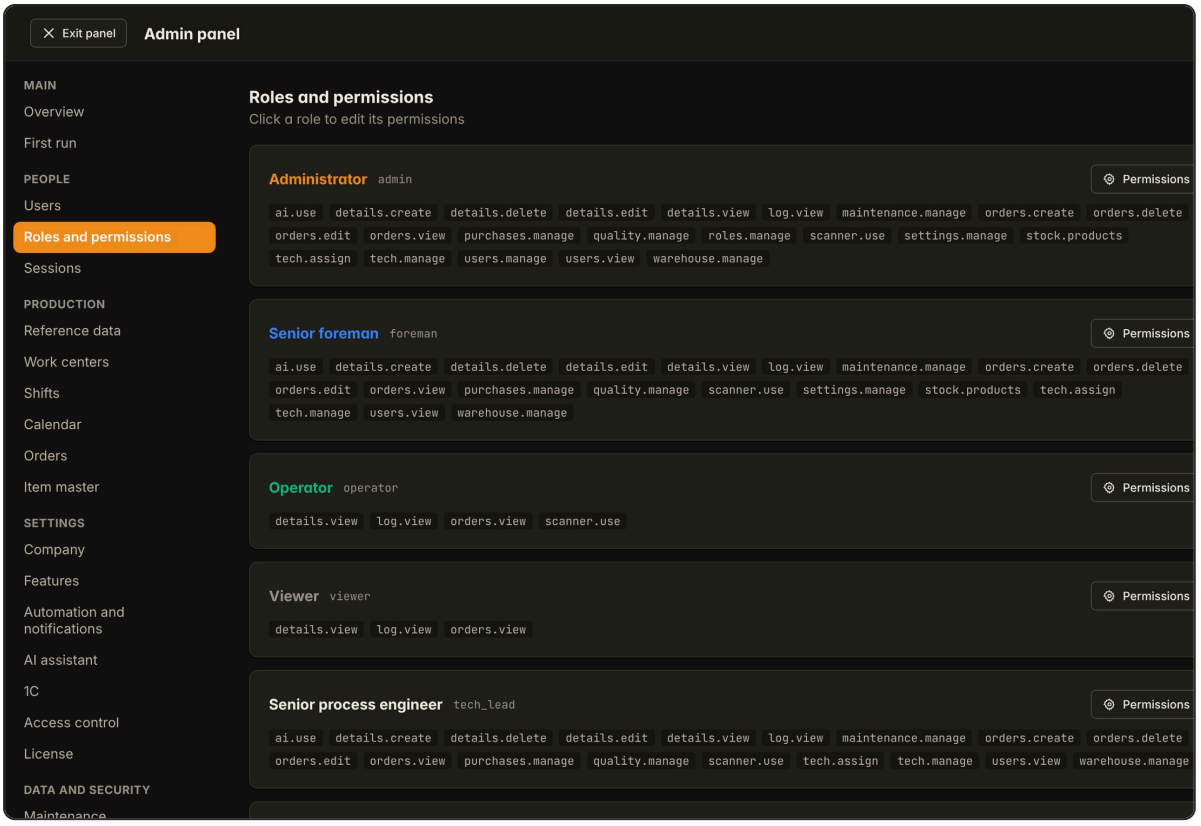


Fig. 1. Admin panel → “Roles and permissions”: each role has its own set of permissions

03 EVERYONE

Principles of working with the software

The software does not run the shop by itself. It shows the truth about the shop exactly as honestly and promptly as data is entered into it. Below are the agreements without which the board, due dates, standards and pay become fiction.

1. **The software is the single source of truth.** An order agreed “verbally”, an operation handed over “on paper”, a defect thrown away without a report — for the system they don't exist. Everything that happens in the shop must appear in the software. If it didn't, it didn't happen.
2. **An event is recorded when it happens.** Started setup — press “Setup”. The first part is running — “Start”. Stepped away — “Pause” with a reason. Handed in — “Hand in”. Recording “after the fact” at the end of the shift breaks actual time, OEE, load and output.
3. **One person — one account.** Everyone has their own badge and PIN; a shared “shift” login is forbidden. Otherwise output, responsibility for defects and traceability become meaningless.
4. **Reference data first, then work.** Work centers, people, the calendar, the item master with routings and standards are set up before orders. An order without a routing is a task without operations, standards or dates.
5. **Raise a problem at once, don't hide it.** The “Problem” or “Breakdown” button is not snitching or an admission of guilt, but a signal to the foreman. Nobody is punished for pressing it; people are punished for a hidden problem.
6. **A reason is mandatory.** Pause, defect, problem, cancellation — always with a reason from the catalog. Without reasons you can't see where time goes and there is nothing to improve.
7. **Whoever is responsible edits.** The item master and standards are edited by the process engineer, the queue by the foreman, the warehouse by the storekeeper, users and permissions by the administrator. Role permissions are set up exactly this way; don't bypass them “through the admin”.
8. **Fix the source, not the consequence.** If actual time keeps deviating from the standard, fix the standard in the routing rather than “adjusting” the records. If a part is being entered a second time, look for the existing card.
9. **Daily data hygiene.** At the end of the day the foreman checks that there are no “hanging” operations, unclosed shifts or problems without a comment. Five minutes a day save hours of analysis at the end of the month.

04 ADMINISTRATOR

Step 0. First run (administrator)

Done once and takes 15–20 minutes. It is easiest to follow the checklist **Admin panel → “First run”**: it shows what has already been done.

1. **Company** — company name and time zone. “Today”, order auto-start and the digest time depend on the time zone.
2. **Work centers (WC)** — Reference data → “Work centers from Excel” (code + name) or one by one. The WC name matters: the operation name is taken from it (“104 Turning” → operation “Turning”).
3. **WC rates and capacity** — Work centers: standard-hour cost (for cost), standard-hour pay (for output), number of seats (for capacity load).
4. **Users** — one by one or “Bulk” as a list. Without a password each user gets their own generated one — save the list right away. Create a **second administrator** in case a password is lost.
5. **Badges for operators** — the badge button on a user: a 4–6 digit PIN (not 1234); a card with a QR code is printed. The operator signs in on a tablet with the “By badge” tab.
6. **Calendar** — days off, holidays, shift length. Start dates by lead time, load and the timesheet depend on it.
7. **Features** — turn on only the modules you need: Tech prep (tools, materials, purchasing), Quality, Traceability, Maintenance, Access control, 1C, Analytics, Telegram. Operation 999 “Kitting” has been off by default since build 813.
8. **Reference data** — downtime reasons (the loss analysis is built on them), defect reasons, the list of materials.
9. **Telegram (optional)** — the bot token, then everyone links their own chat: notifications, the morning digest, the weekly summary.

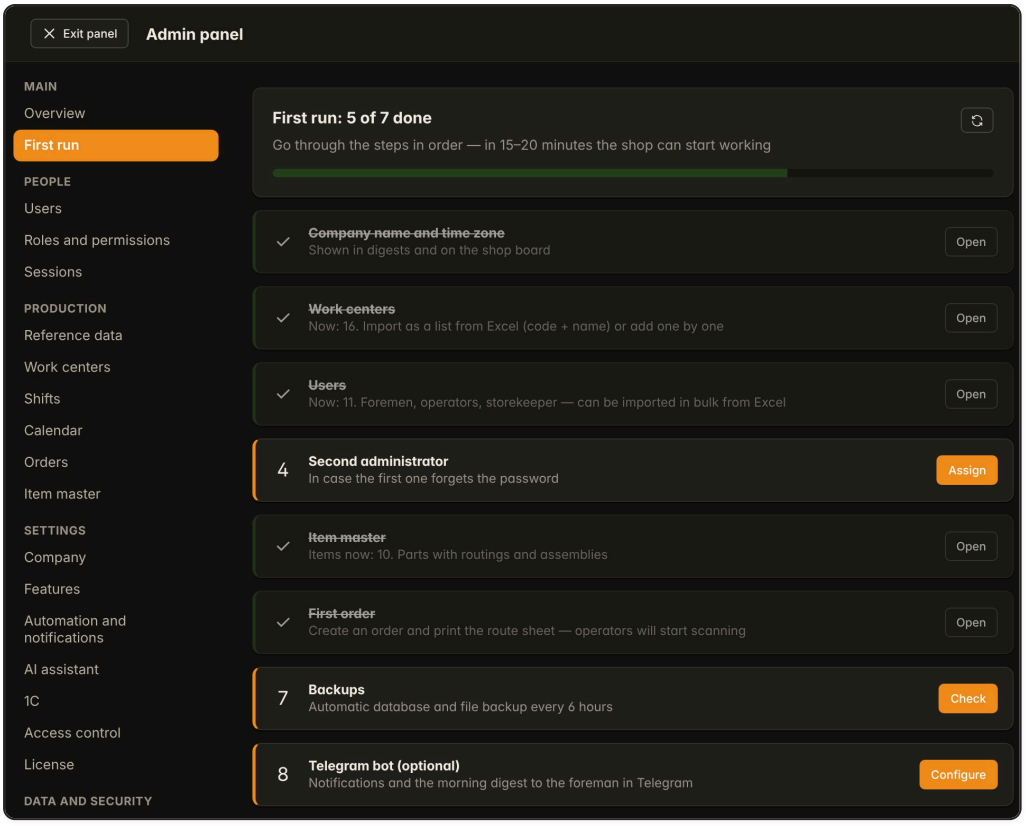


Fig. 2. Admin panel → “First run”: the checklist marks completed steps by itself

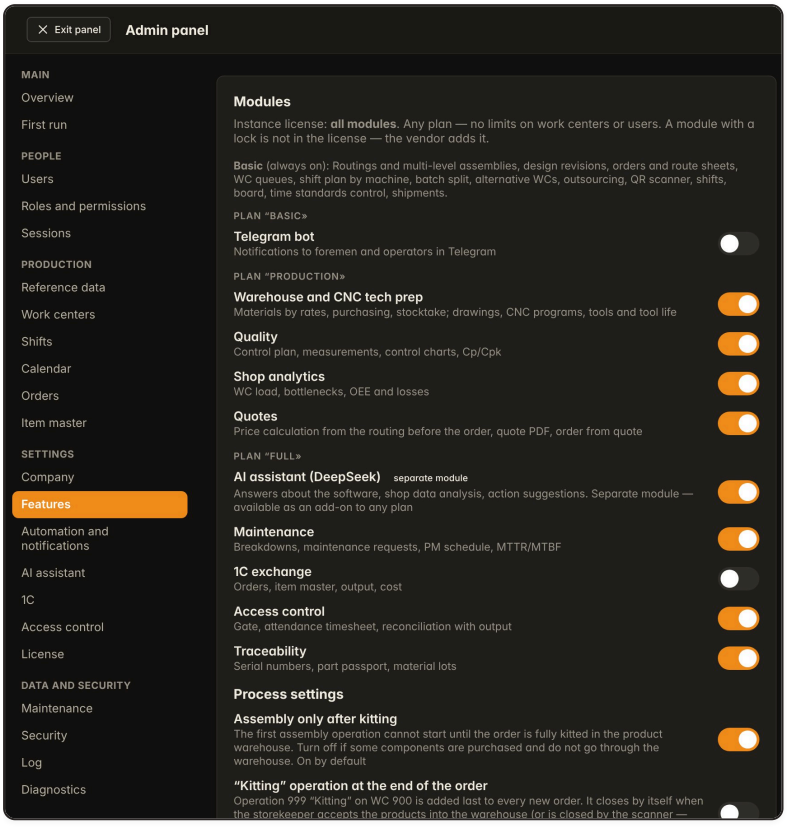


Fig. 3. Admin panel → “Features”: modules are turned on with switches

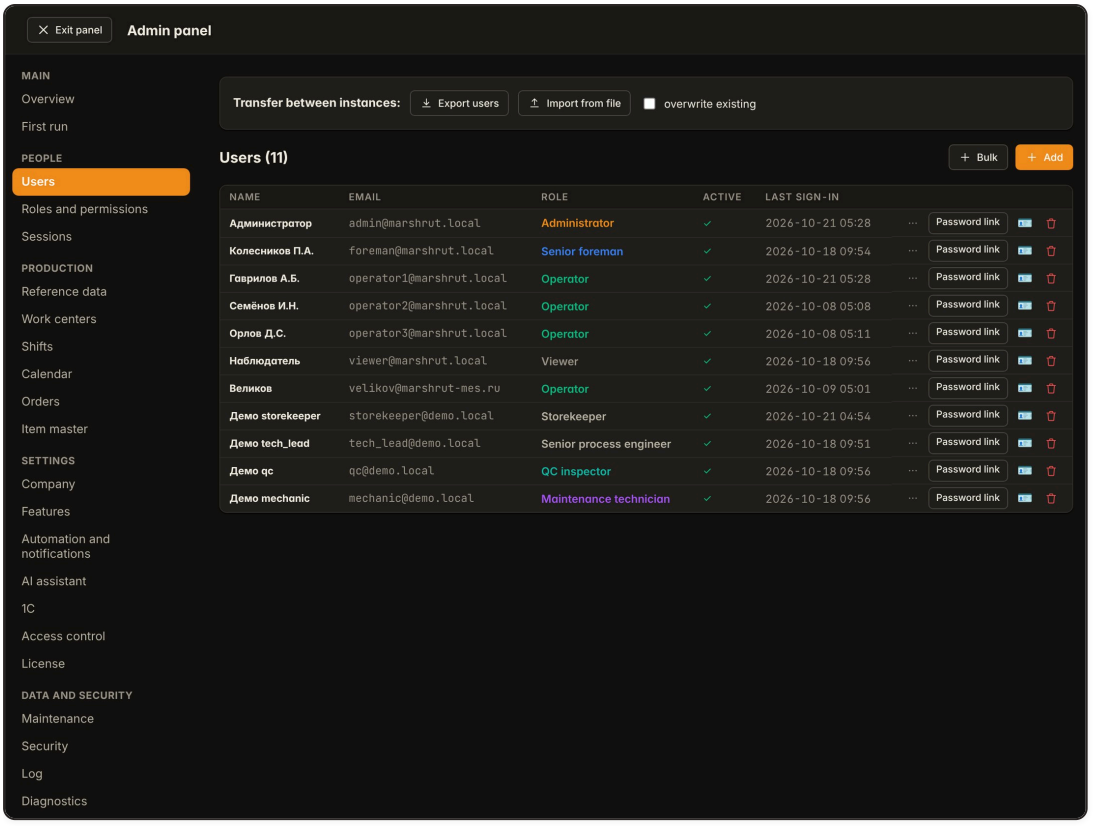


Fig. 4. Admin panel → “Users”: role, email, last sign-in, password reset link

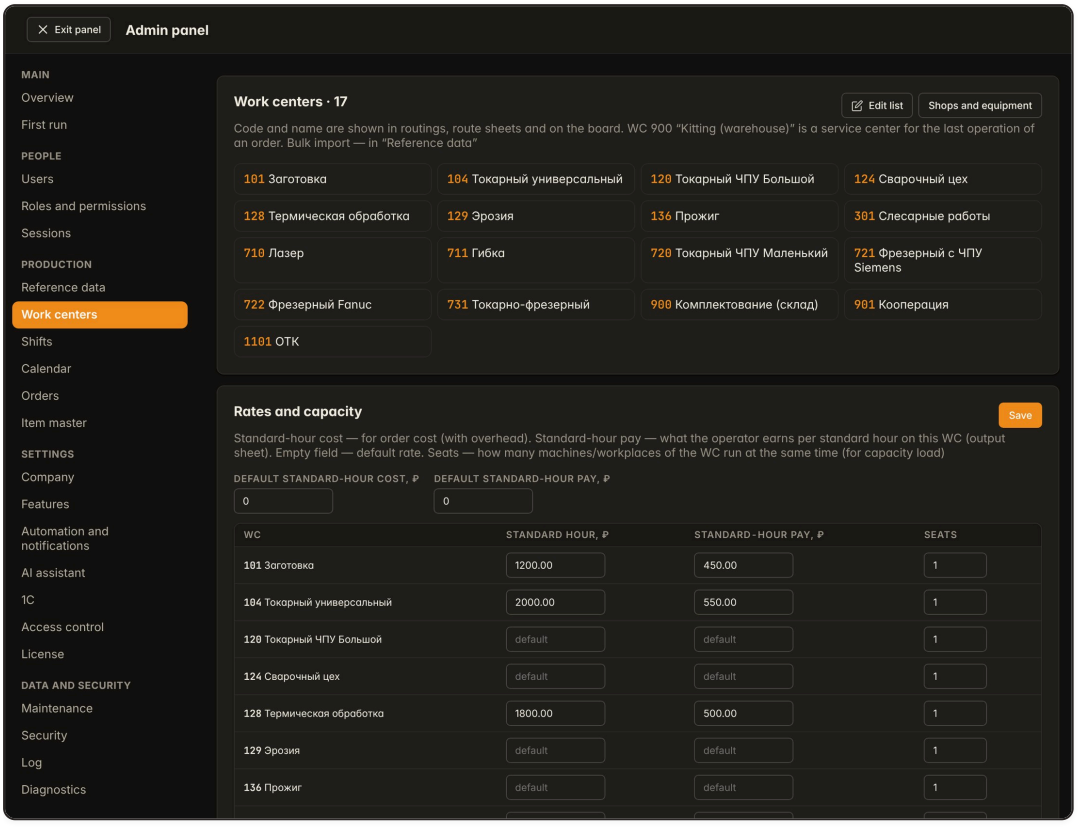


Fig. 5. Admin panel → “Work centers”: WC codes, standard-hour rates and number of places

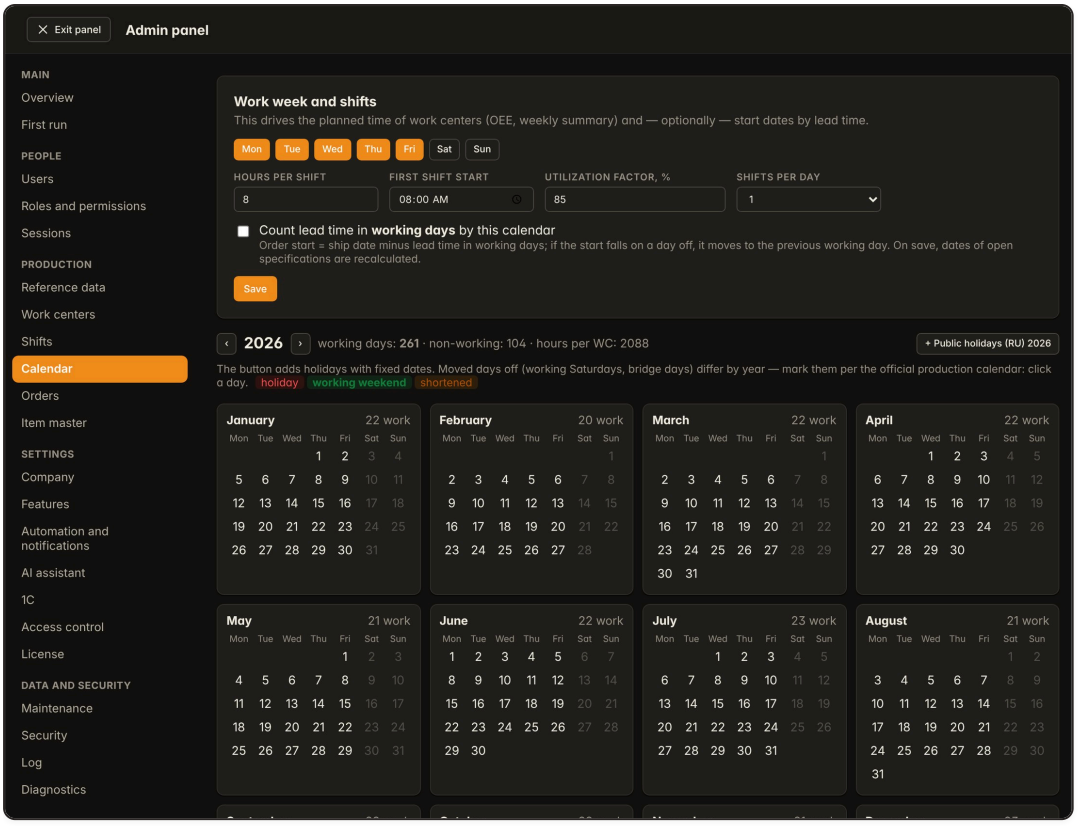


Fig. 6. Admin panel → “Calendar”: work week, shifts, holidays and moved days

05 PROCESS ENGINEER

Step 1. Item master and routings (process engineer)

The item master is the only source of how a part is made. An order copies the operations from the routing at the moment it is created, so the routing must be finalized **before** the order. Section: Preparation → Item master.

1. **Part or assembly.** A part is made by operations; material is required. An assembly consists of other items (“Assembly structure” → item and quantity per 1 pc) and can have its own operations — assembly, welding, QC. The list shows a “Part / Assembly” mark.
2. **Code and drawing.** The code is unique: the software won't let you create a duplicate, even if it differs by Latin/Cyrillic letters, a space or case. The drawing is filled in from the code and can be corrected.
3. **Operations.** Added in steps of 5 (005, 010, 015...). First choose the WC — the name fills in by itself. The number can be corrected; operations sort in ascending order. This way there is always room for 012 between 010 and 015.
4. **Time standards.** Run — minutes per part, Setup — setup per batch (once per order). Total = Setup + Run × quantity. Time standards control, load and cost are calculated from them, so zeros in the standards break the reports.
5. **CNC.** An operation on a CNC machine gets the “CNC” flag — then it goes into the Tech prep queue and waits for a CNC program.
6. **Lead time** — how many days from start to completion. The software calculates start dates from the ship date using lead times.
7. **Material consumption rates** — how much material per 1 pc. Without them requirements, reservations and material cost are not calculated.
8. **Files** — drawing (PDF), CNC program, setup sheet, 3D model. Versions are kept; the operator sees the latest one right at the machine.

A similar item is faster to create with the “Create similar” button. An item that is in orders or in an assembly structure cannot be deleted — this is protection, not an error.

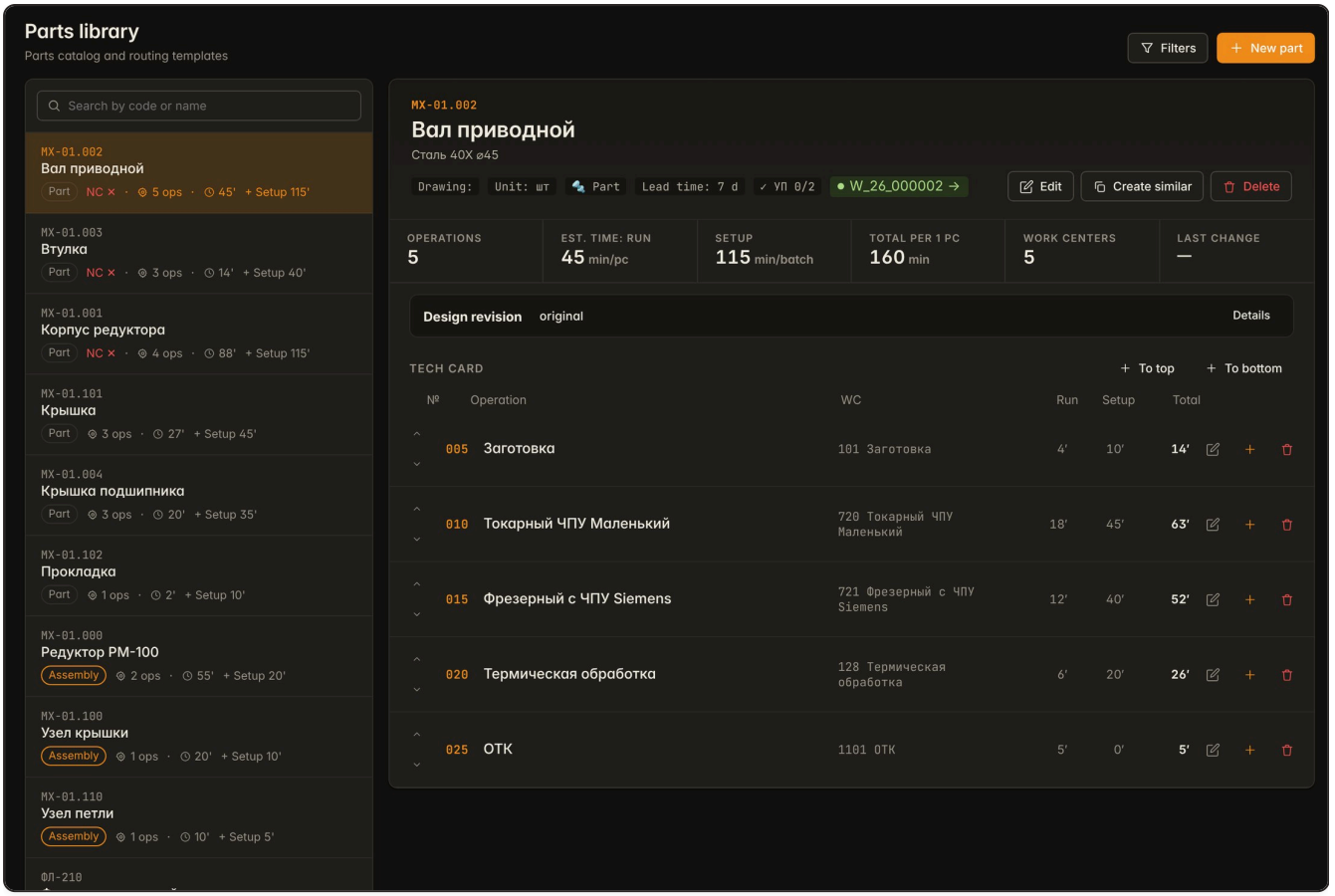


Fig. 7. Item master: a part card with its routing — operations in steps of 005, WC, run and setup time

06 FOREMAN · MANAGER

Step 2. Specification: customer order → production orders

A specification (SP-...) is “what the customer wants and by what date”, and an order (W_...) is “what and how much the shop makes”. One specification is broken down into several orders — one for each line of the tree.

1. **Create** — “New specification” or import from Excel using the template (level, type, name, code, quantity). Enter the customer and the ship date.
2. **Structure (tree)** — parts and assemblies from the item master (an assembly is expanded in full). A line without a routing can be typed in manually — the process engineer will later click “Link item” or create it from “Tech prep → From specifications”.
3. **Specification statuses:** “In development” (with the process engineer) → “Waiting” (ready, waiting to start) → “In production” → “Completed”.
4. **Create orders** — in the “In production” status, the “Create all orders” button (or “Order” on a line). Dates are calculated automatically: **start = due date − lead time**, a component's due date = the start day of the assembly it belongs to.
5. **Control** — the “Schedule (Gantt)” and “Labor and lead time” tabs: how many standard hours and when it will really be ready given the shop load. Change the ship date — the dates of all orders are recalculated.

A one-off part without a specification — straight to “New order” in Orders. But if there is a product and a ship date, always start with a specification: only then are the dates linked and the product's readiness visible.



Fig. 8. Specifications: customer order, ship date and readiness of its orders

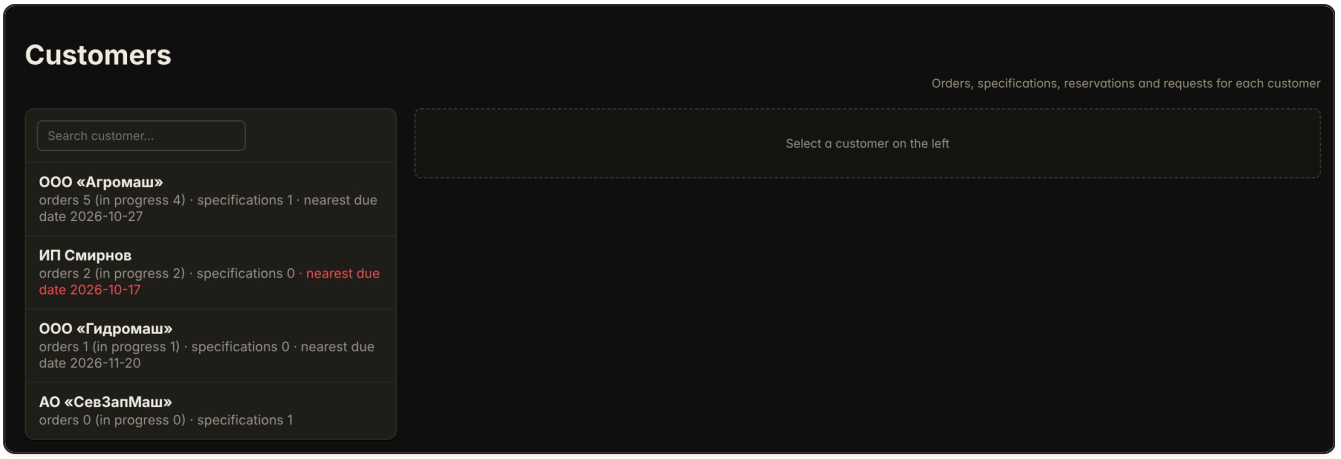


Fig. 9. Customers: orders, specifications and nearest due dates for each customer

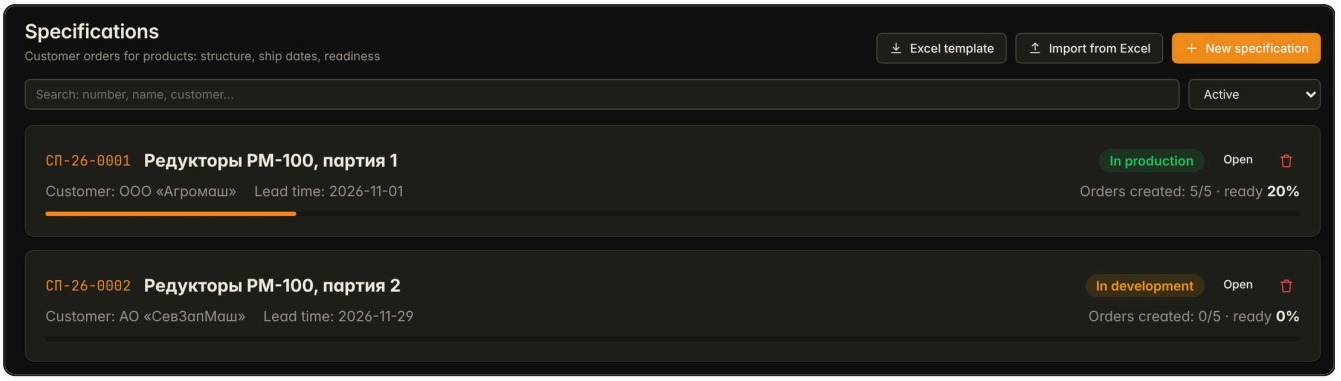


Fig. 10. Specification: structure tree, each item with release and due dates by lead time and a link to its order

07 FOREMAN

Step 3. Order: statuses, start, route sheet

An order's status decides one thing: **can the shop work on the order now**. Operations appear on work centers and are taken into work only for an order “In progress”.

Status	Meaning	Work on the shop floor	Who sets it
Draft	the order is being prepared	not allowed	foreman
Planned	waiting for the start date	not on WCs	foreman / specification
Waiting for material / equipment / approval	not started, the reason is shown	not on WCs	foreman
In progress	started	allowed	foreman or auto-start on the start date
⚠ Problem	no material, no tool, a question about the drawing	the whole order stops	anyone (with a reason); only a foreman clears it
Suspended / Cancelled	work stopped	not allowed	foreman
Completed	all operations closed	—	automatically (if an operation is taken again, it returns to work)
Shipped → Archive	order closed	—	foreman in “Order archive”

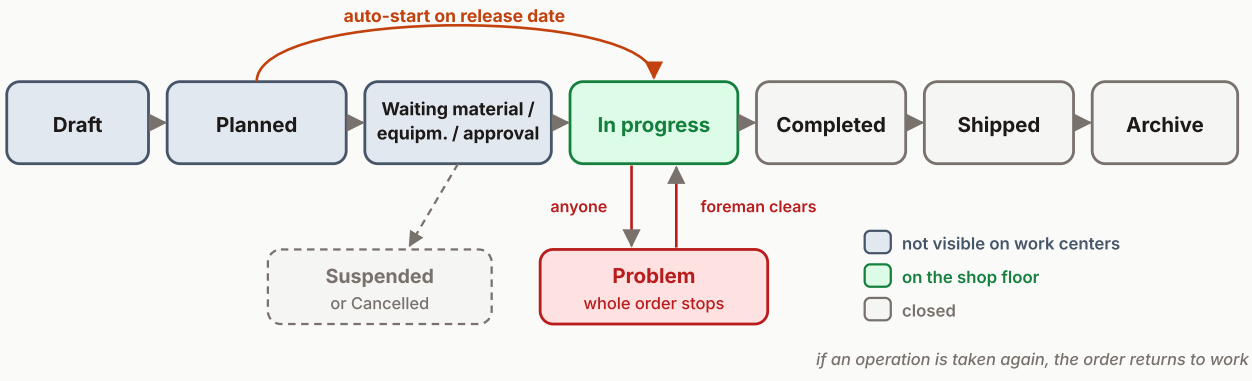


Diagram 2. Order life cycle: the shop sees only orders “In progress”; “Problem” stops the whole order

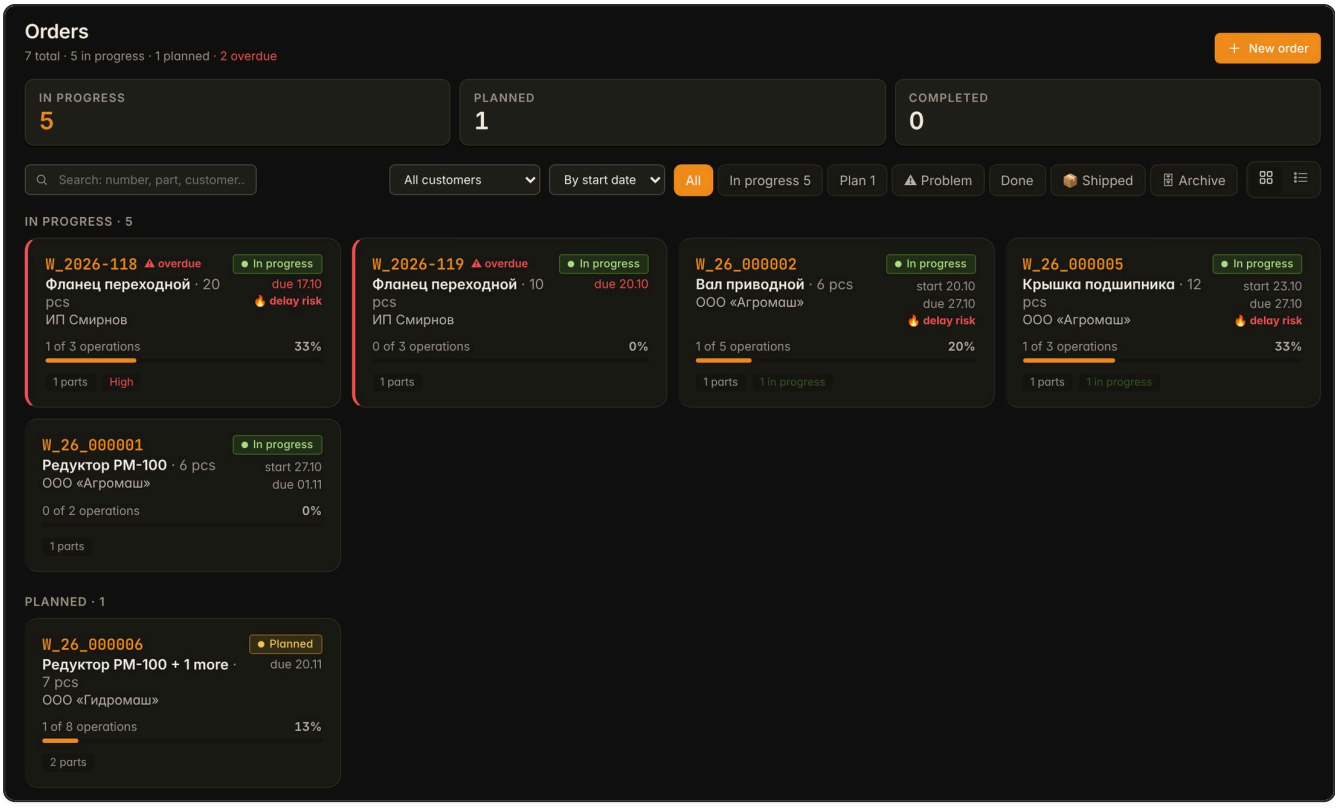


Fig. 11. All orders: cards with status, due date and progress

How to work with an order:

1. Check the “Structure: quantity, kitting, time” card — what we make, how many, plan Setup/Run/Total, what is already in the warehouse.
2. If needed, edit the operations **of this order** (“▼ operations” on the part): “To top”, “+” in between, ✎ — number, WC, time, quantity. Only unclosed operations change; the item master is not touched. Everything is written to “Edit history” and “Route revisions”.
3. Move the order to “In progress” (or turn on auto-start in Admin panel → Automation).
4. Print the **route sheet** — each operation has its own QR code. The sheet travels with the parts through the shop. A reprint marks the operations already closed.
5. While work is in progress, watch the card: plan/actual time, operator comments, order materials, cost.

If a part has several orders, the assembly structure shows all open orders for it and how many are done in each. The product warehouse is shared: the kit takes what was accepted into the warehouse, regardless of which order made it.

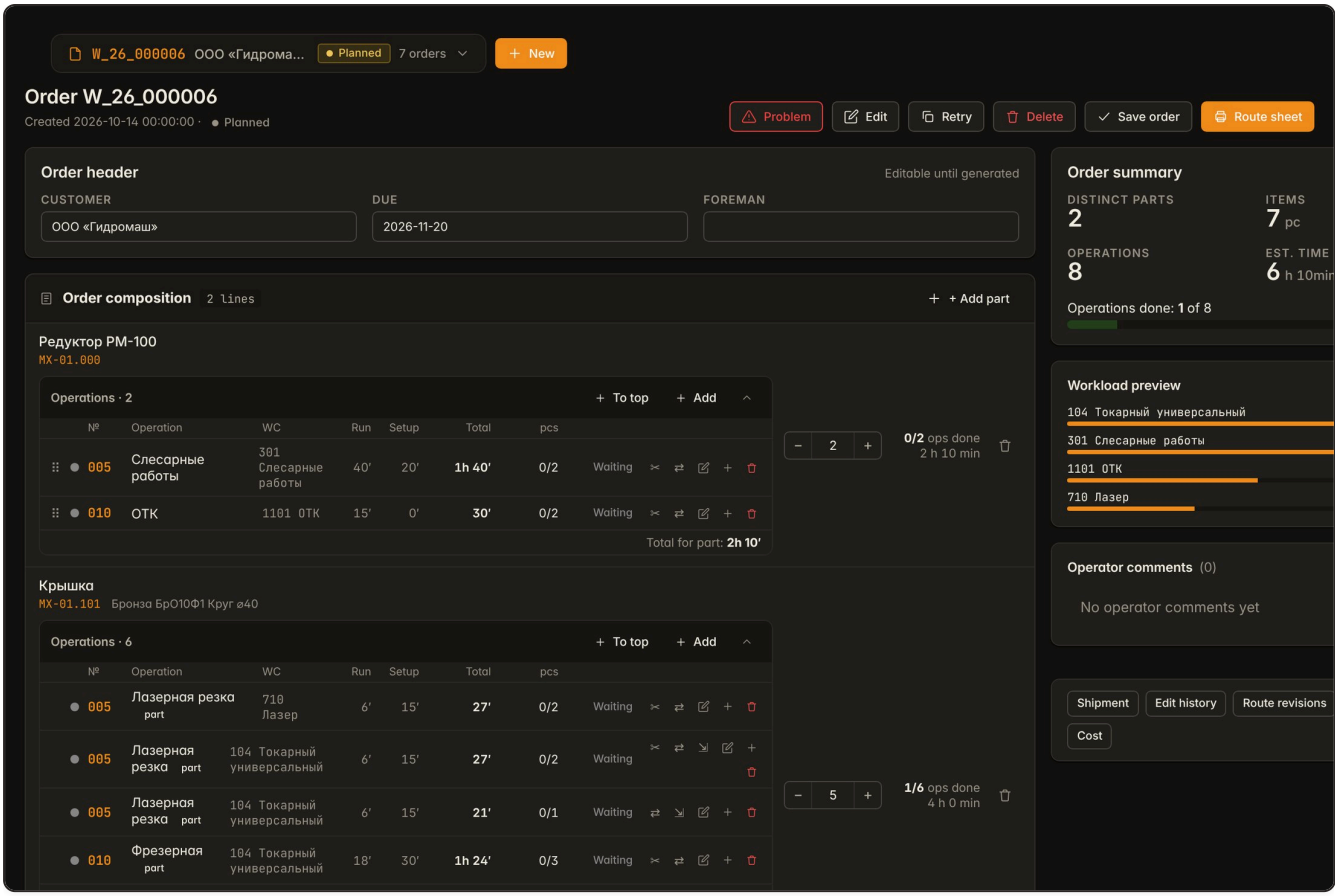


Fig. 12. Order card: parameters, editable operations, summary and WC load

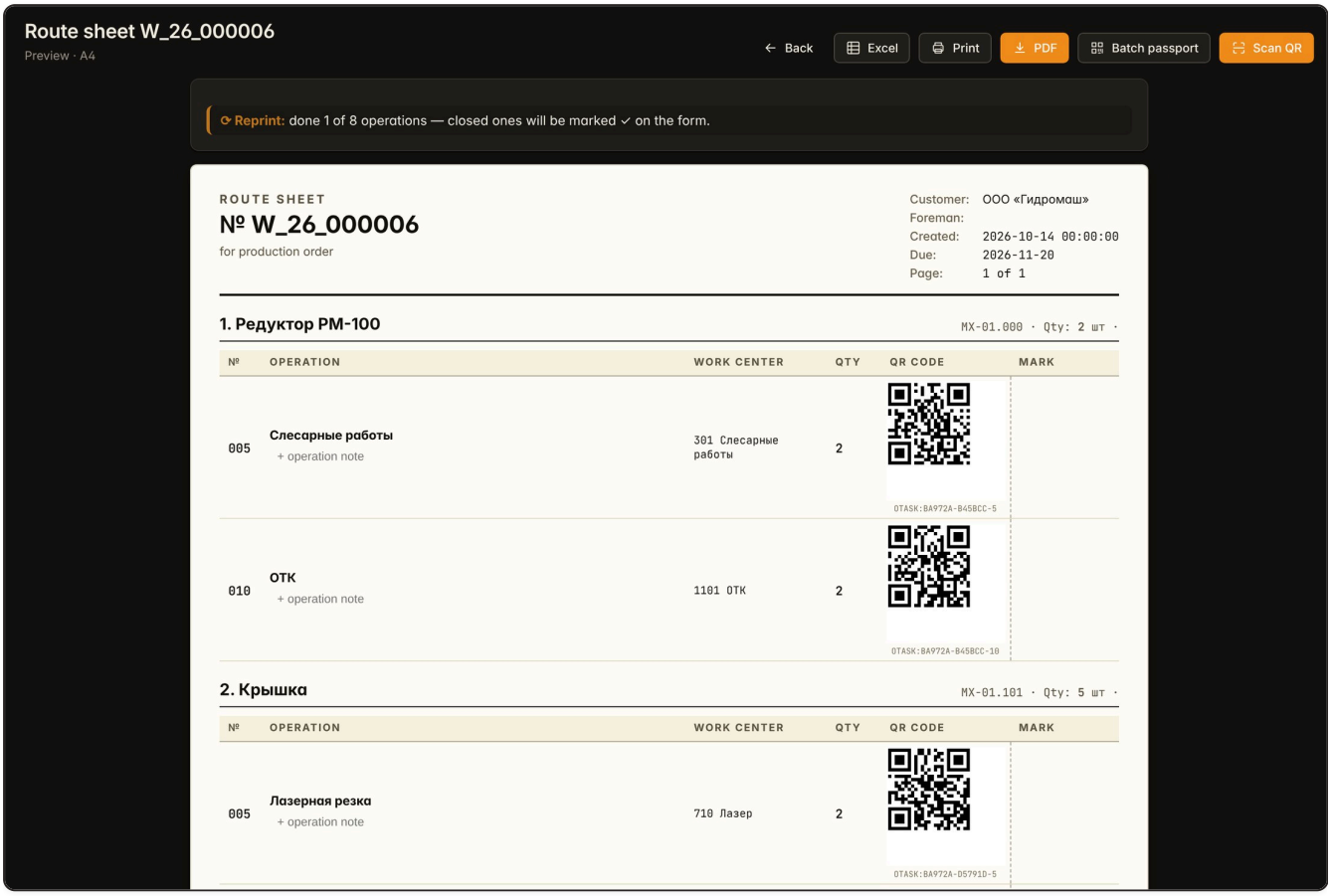


Fig. 13. Route sheet: each operation has its own QR code

08 CNC PROGRAMMER · WAREHOUSE

Step 4. Preparing for launch: programs and materials

Before tasks go to the shop, every order must have **CNC programs** and **material** ready. Otherwise the operator gets a task that can't be done.

Tech prep (CNC programmer)

1. Open **Tech prep**: it has the queue of CNC operations of orders that have no ready program.
2. Assign a person and set the status “In progress”.
3. Upload the CNC program file. Every new upload becomes a new **version**; old ones are kept.
4. Set “Done”. The program goes to the **library** and is used in the next orders for this part and operation.
5. Create requests for programs without an item (one-offs) here as well. When the part appears in the item master, **link** the request to it so the program is not lost.

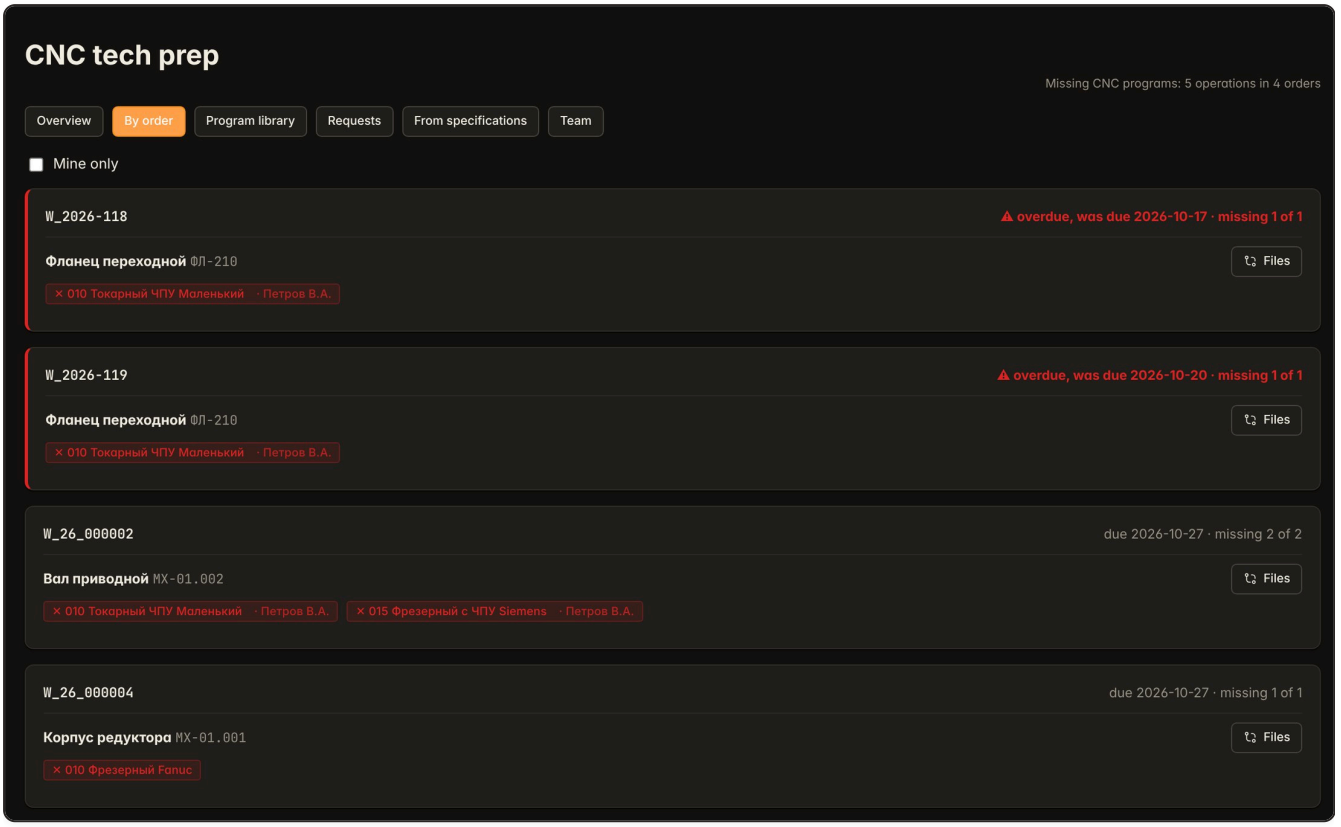


Fig. 14. Tech prep → “By order”: which programs are missing and who is assigned

Materials (storekeeper / purchasing)

1. **Consumption rates** are set in the item card (Step 1). Without a rate the system can't calculate the requirement.
2. **Warehouse → Requirements** shows how much material is needed for started orders and how much is missing.
3. The **“Order”** button creates a purchase for what is missing.

4. A purchase goes through the statuses **draft → sent → receipt**. On receipt be sure to enter the **lot** (heat or certificate number). It is needed for traceability.
5. **Reserve** the material for the order so it isn't taken for another one.
6. Issue material to the shop **by order**, not “to the section”. This way the write-off is tied to a specific order and lot.

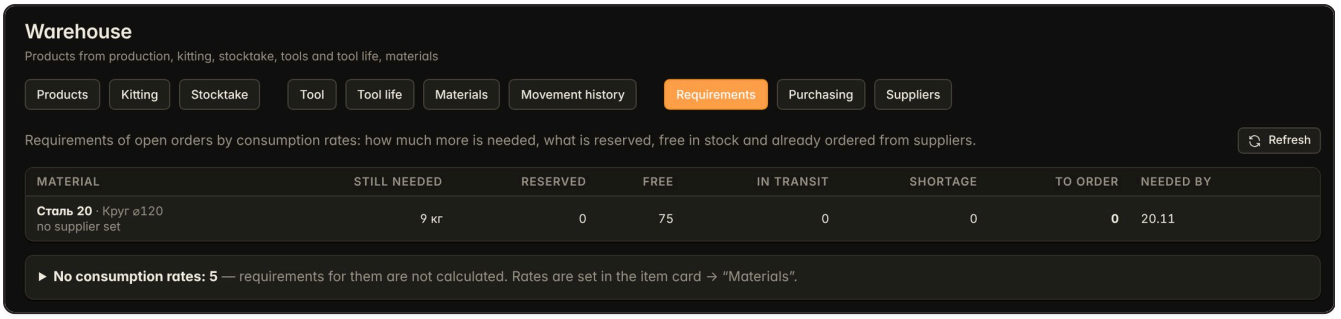


Fig. 15. Warehouse → “Requirements”: shortage by consumption rates and the “Order” button

> Rule: an order can be started when the programs for its CNC operations are “Done” and the material is reserved.

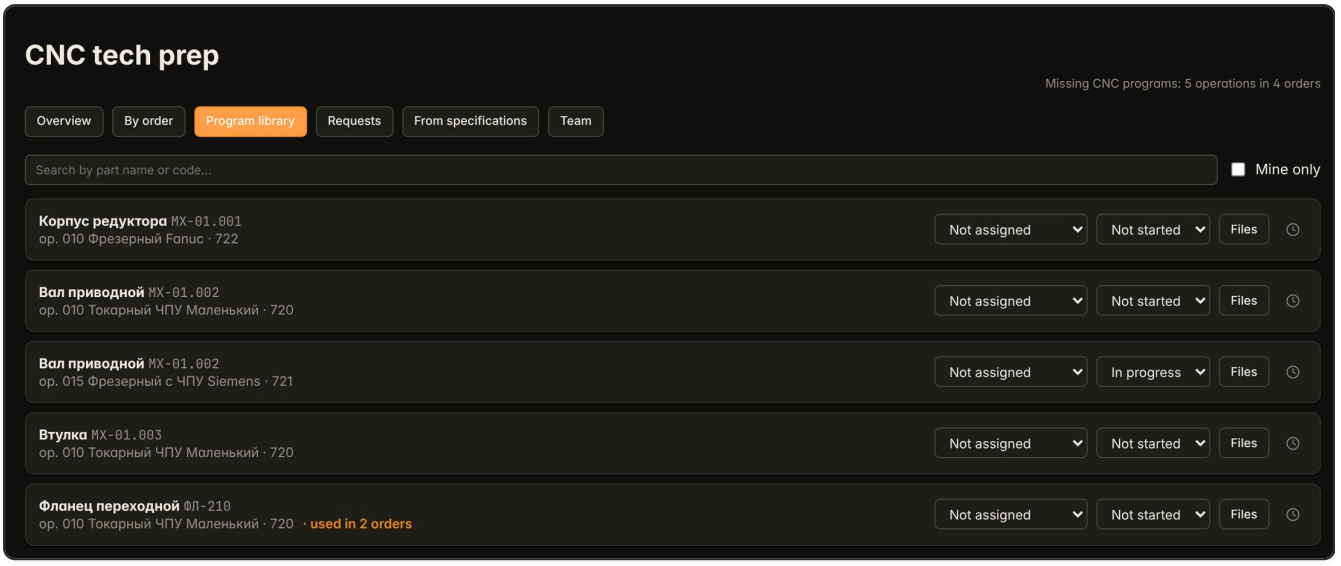


Fig. 16. Tech prep → “Program library”: programs by operation, assignee and state

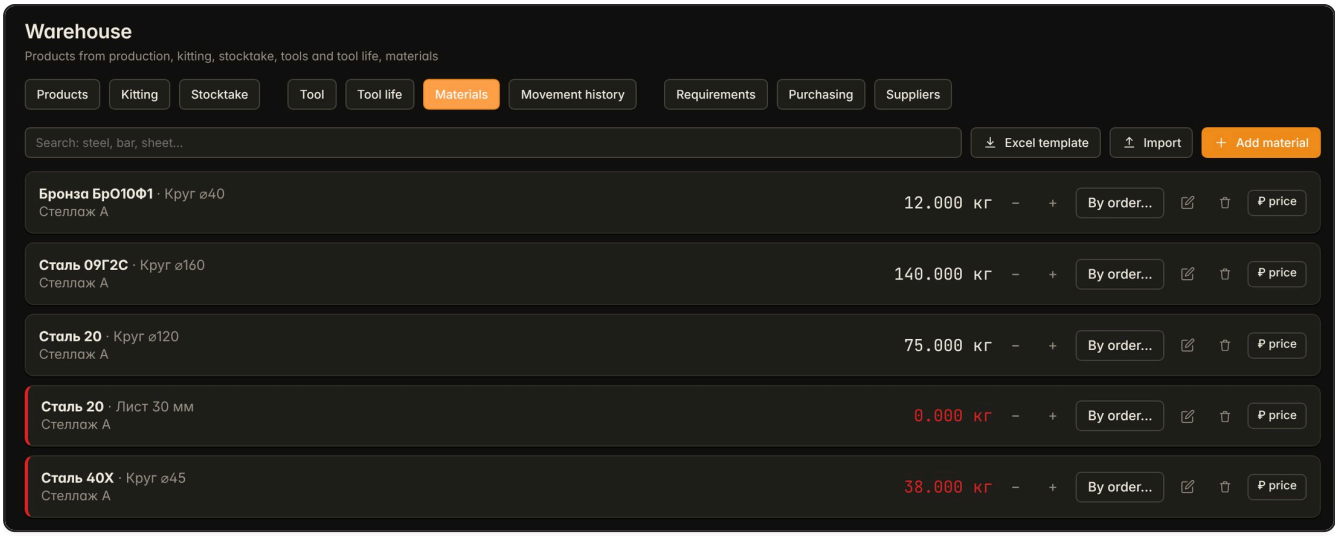


Fig. 17. Warehouse → “Materials”: stock, grade and size; red — below minimum stock

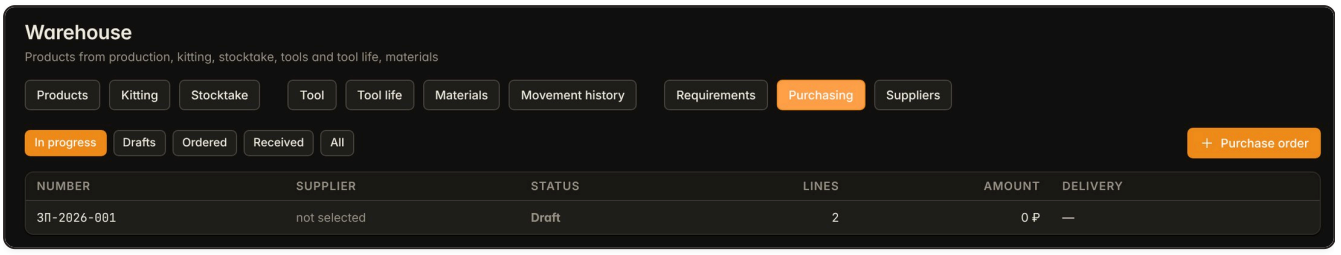


Fig. 18. Warehouse → “Purchasing”: draft from “Requirements” → sent → received with a lot

09 OPERATOR

Step 5. Shop floor: how the operator works

The operator's main rule: **every action is recorded when it happens**, not at the end of the shift. The foreman's board, the actual Setup/Run calculation and pay depend on it.

Start of shift

1. Sign in with your **badge** (card or QR) and enter your **PIN**. Email and password are only for those without a badge.
2. Click **“Start shift”** and choose the machine or work center you work at.
3. Open **“My tasks”**: it has the queue for your WC in the order set by the foreman. Don't take tasks out of turn without the foreman's instruction.

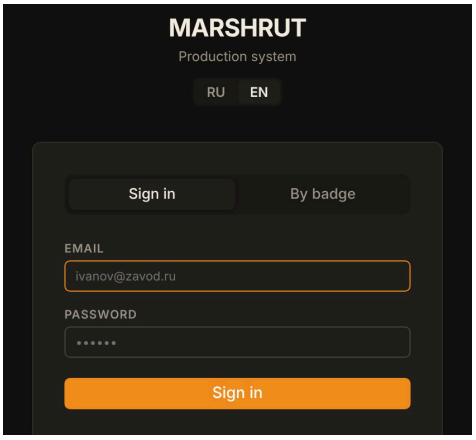


Fig. 19. Sign-in: the “By badge” tab — card or QR and PIN

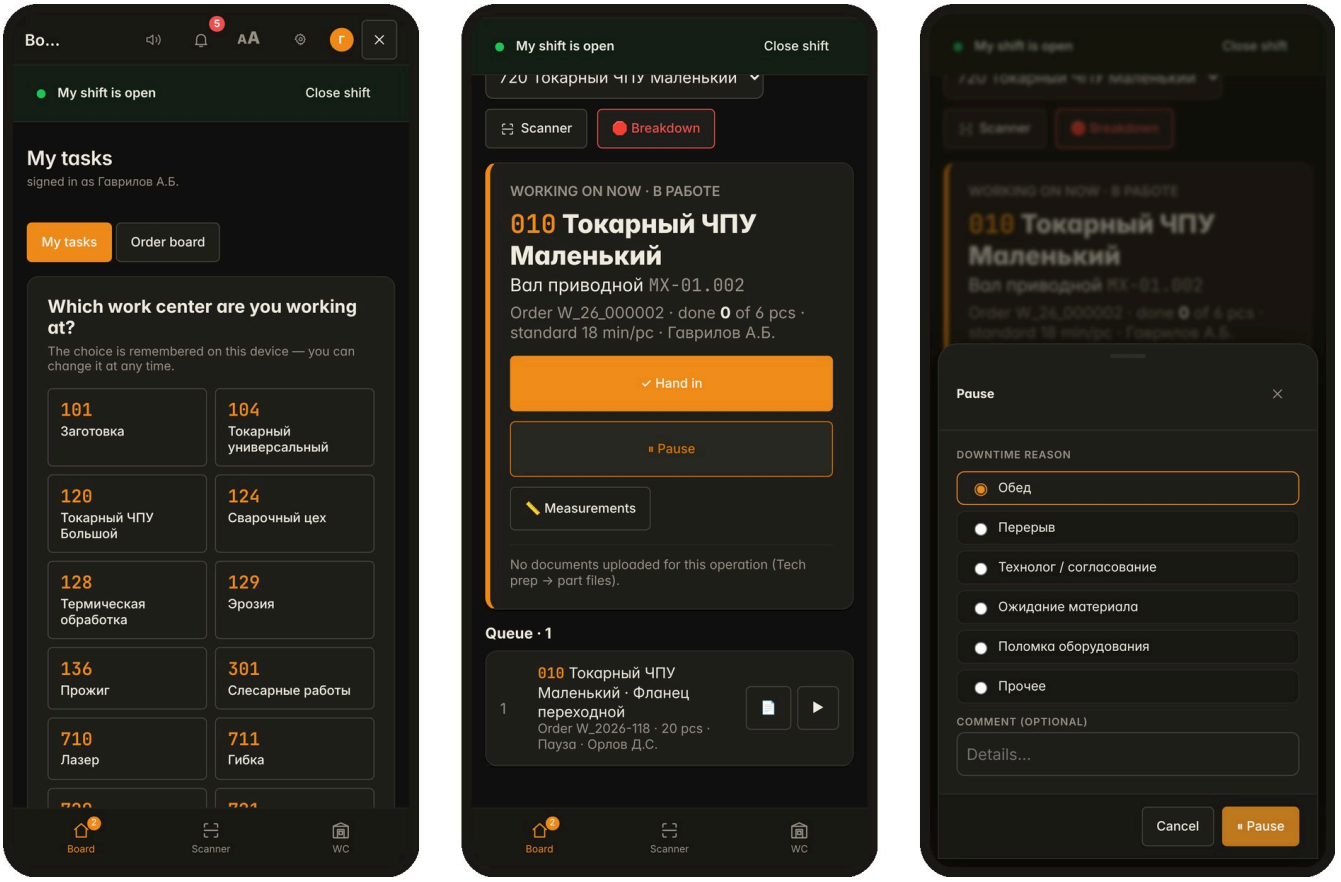


Fig. 20. Operator phone: choose a WC → “My tasks” → pause with a reason

Working on a task

1. Find the task in the list or **scan the QR** on the route sheet. The scanner opens the right operation immediately.
2. **Setup.** Press “Setup” when you start setting up the machine. Setup time goes into actual Setup.
3. **Start.** Press “Start” when the first part is running. Time goes into actual Run.
4. **Pause.** If work stops (lunch, no tool, waiting for QC), press “Pause” and **choose a reason**. In OEE and the downtime report this time counts as downtime for the chosen reason, not as work.
5. **Hand in.** Enter the number of good parts and defective ones, if any.

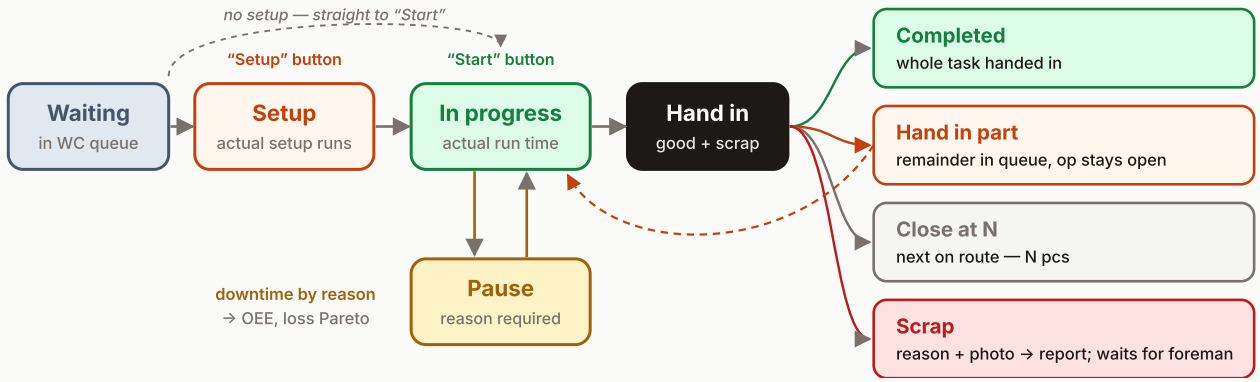


Diagram 3. Operation life cycle at the machine: which buttons record what

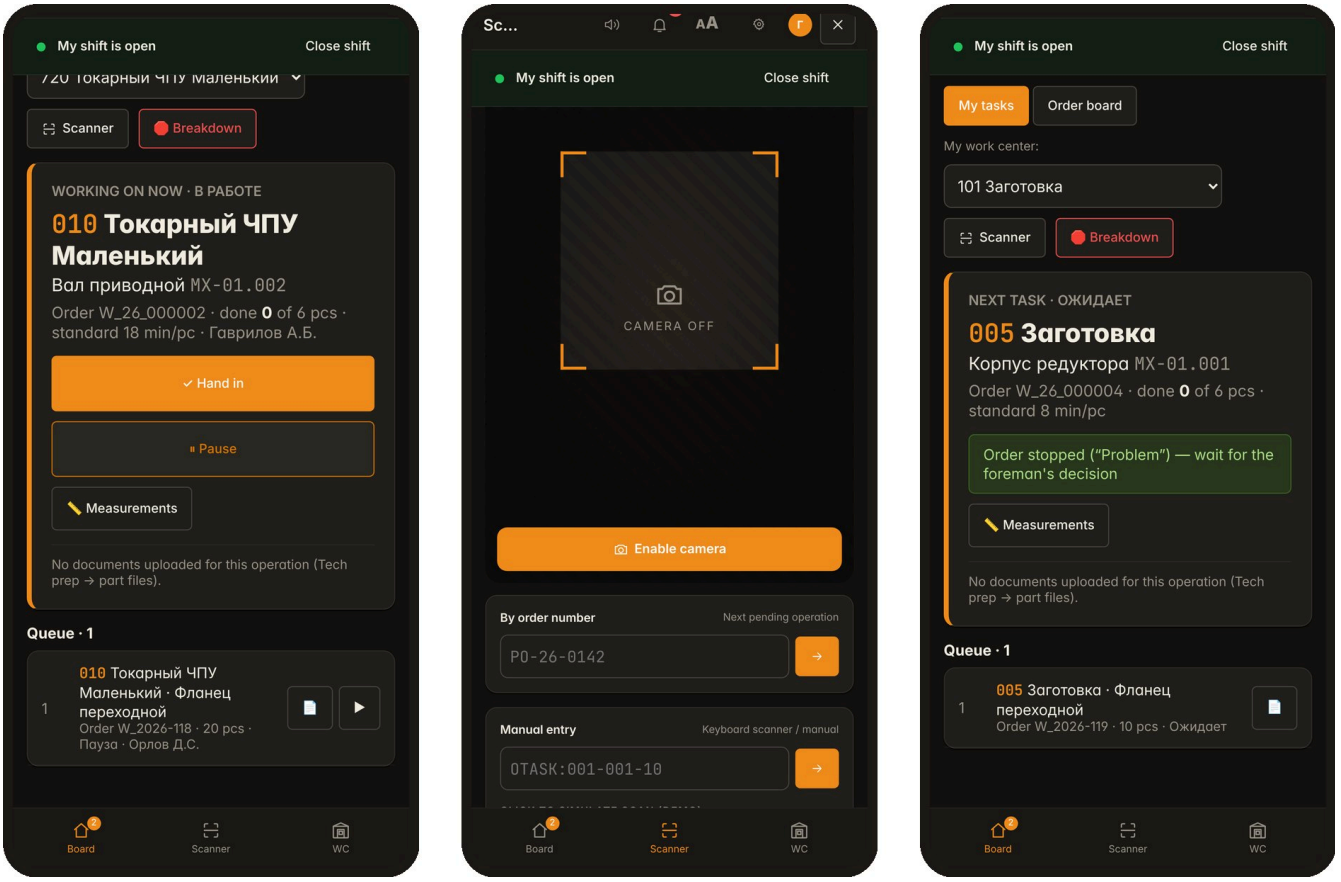


Fig. 21. Operator phone: current task, QR scanner, next task with setup

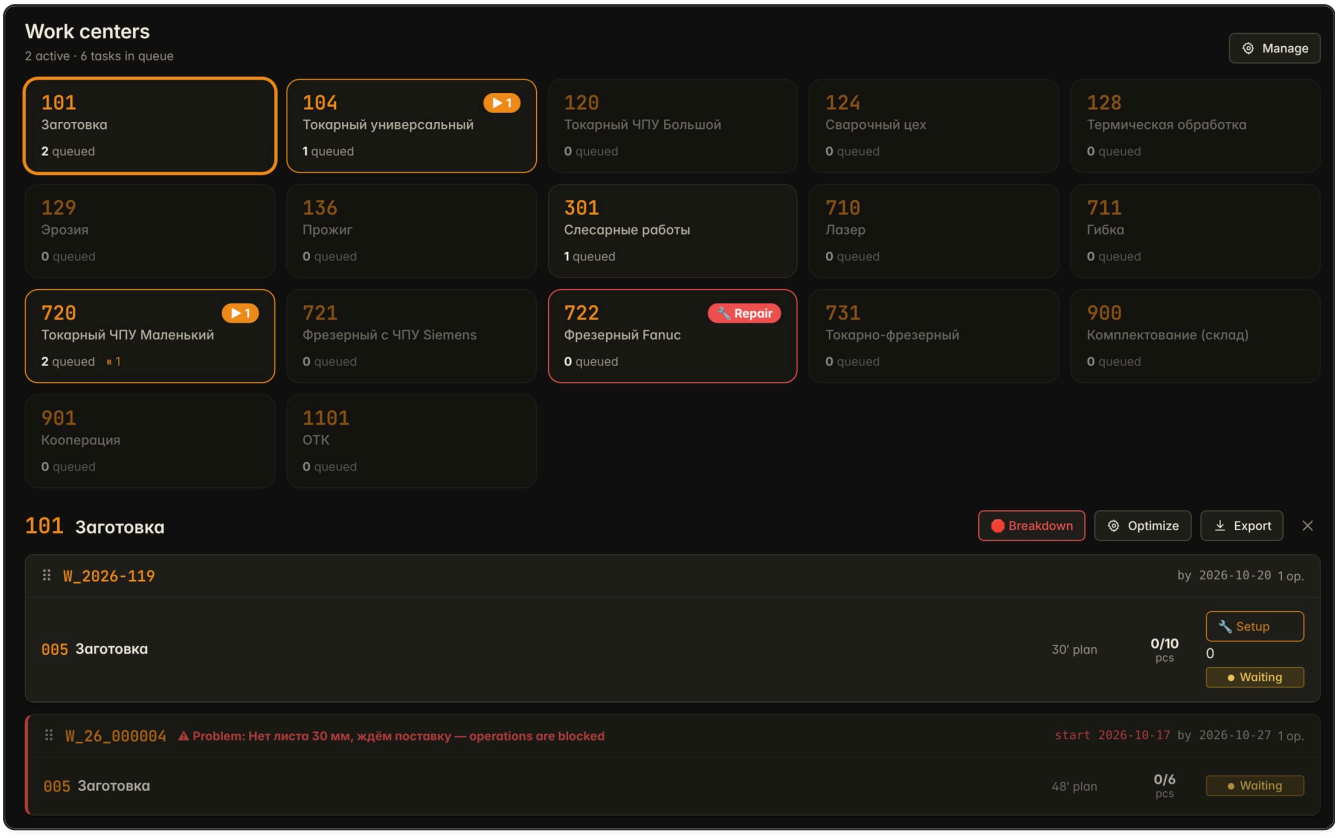


Fig. 22. WC queue: an operation with setup time shows "Setup" first, then "Start"

Handed in less than the task

The system asks what to do with the rest. Choose one of two options:

Option	When to choose	What happens
Hand in part	The rest will be finished later (by you or the next shift)	The operation stays open; the remainder is shown in the queue
Close at N pcs	No more will be made (not enough blanks, foreman's decision)	The operation is closed. For all following operations the order quantity becomes N

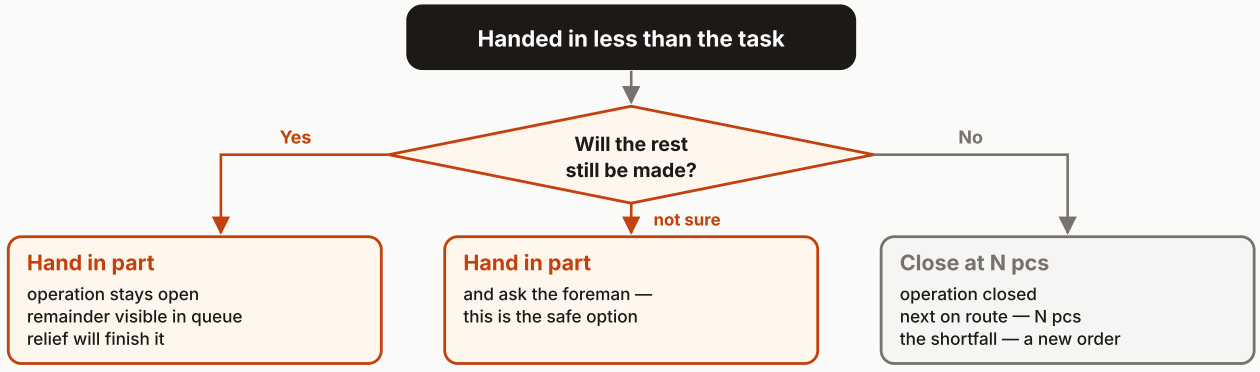


Diagram 4. “Hand in part” or “Close at N”: how to decide

> If in doubt, choose “Hand in part” and ask the foreman. Closing at N changes the quantity along the whole remaining route.

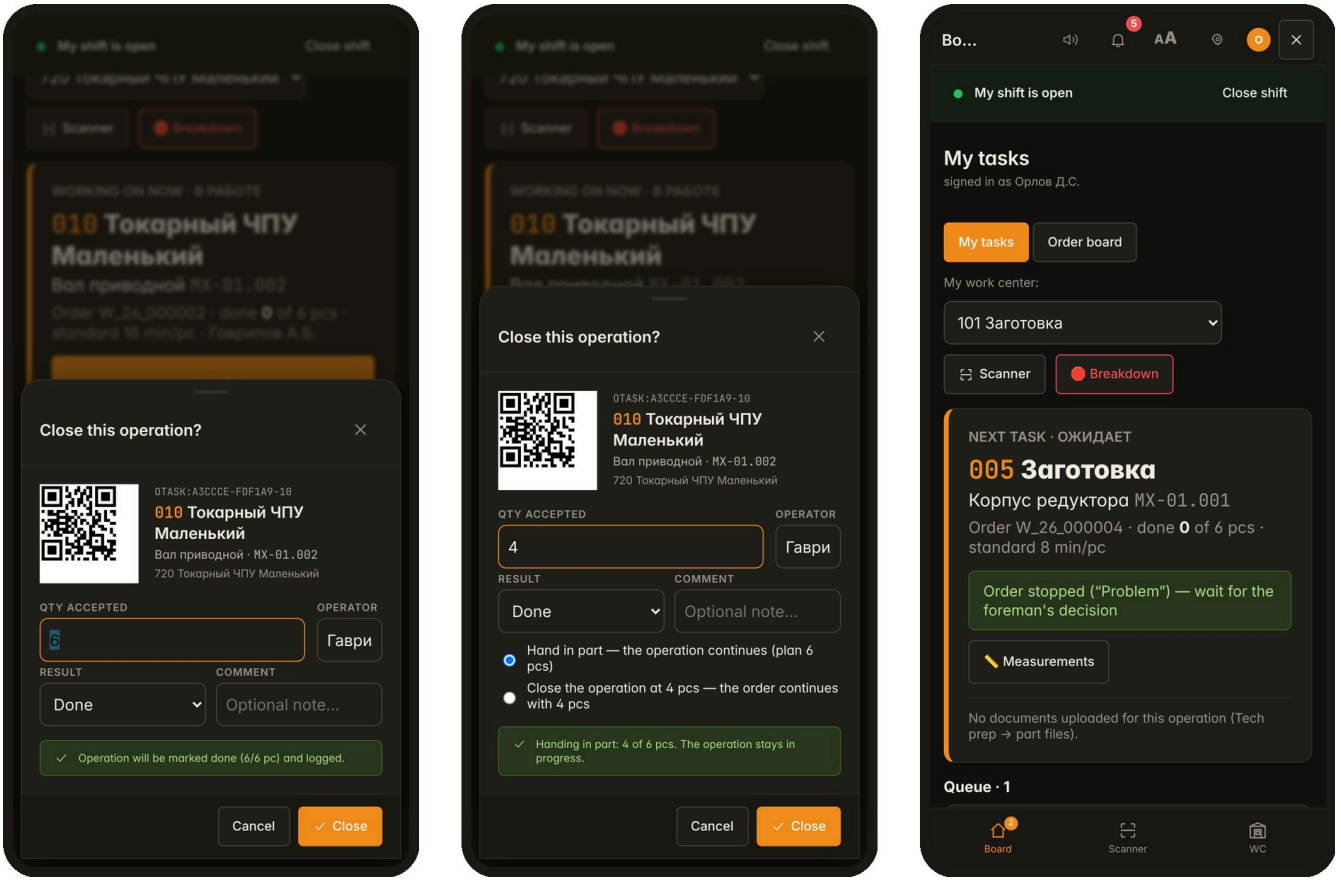


Fig. 23. Hand-in: full quantity; less — choose “Hand in part” / “Close at N”; an order in “Problem” won't start

Defects, problems, breakdowns

- **Defect**: enter the quantity and reason, attach a **photo**. A defect report is created.
- **“Problem”**: no material, no program, an error in the drawing. Choose a reason and the foreman sees it on the board immediately.
- **Machine breakdown**: the “Breakdown” button creates a maintenance request (if the module is on), and the machine is marked as down.

End of shift

1. **Do not close** an unfinished operation. Hand in what is done with “Hand in part”.
2. Click **“Hand over shift”** and briefly write what is left: the state of the setup, what's up with the tooling.
3. Click **“End shift”**.

10 QC

Step 6. Quality (QC)

The module is turned on in **“Features”**. If it is off, inspection is recorded only through defect marks at hand-in.

1. **Control plan.** The process engineer or QC specifies in the part card which operations to measure and what: dimension, nominal, tolerance, frequency (first part, every Nth, last).
2. **First part.** After setup the operator hands in the first part for inspection. The series starts only after it is marked “Pass”.
3. **Measurements.** The inspector enters actual values. Out-of-tolerance values are highlighted immediately.
4. **Defect decision**: reworkable (rework) or final (scrap), with the cause and who is responsible.
5. All measurements and decisions are linked to the order and the material lot. They are visible in **Traceability**.

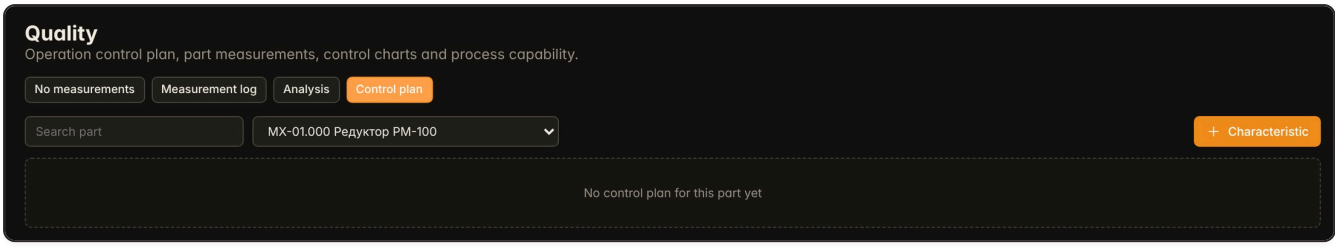


Fig. 24. Quality → “Control plan”: dimensions, tolerances, instrument and frequency by operation

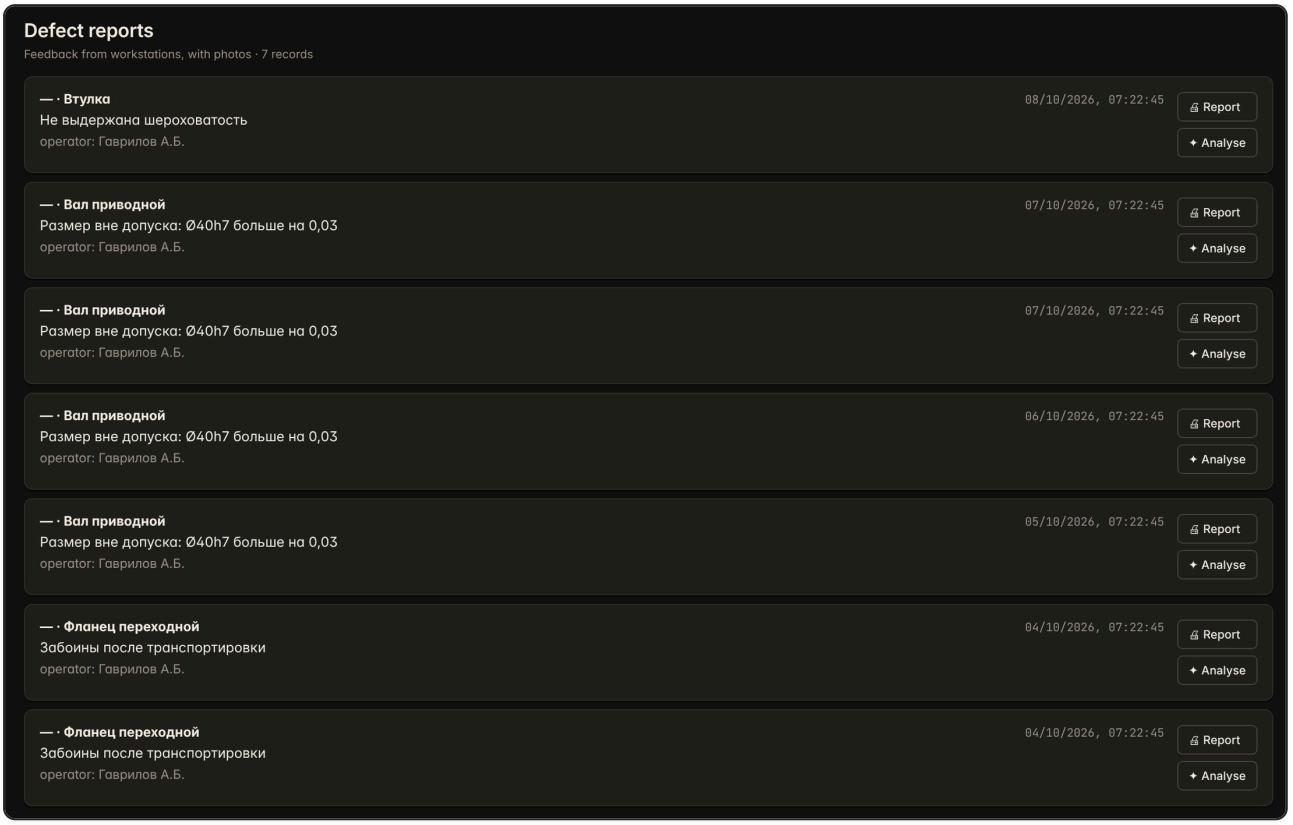


Fig. 25. Defect reports: part, cause, operator and photo — the basis for a “5 whys” review

11 STOREKEEPER

Step 7. Product warehouse: acceptance, kitting, shipment

1. **Receipt.** When the last operation of an order is closed, the parts automatically appear in **“Awaiting acceptance”**. There is no need to create a receipt manually.
2. **Acceptance.** The storekeeper counts and confirms the actual quantity. A discrepancy with what was handed in is a reason to sort it out with the foreman, not to accept it “as is”.
3. **Kitting assembly units.** The structure card shows which parts are sufficient and how many kits can be assembled. An assembled kit writes the parts off from the warehouse. Turn on operation 999 “Kitting” in the route only if kitting is done by the shop (it is off by default).
4. **Shipment.** In the order card — the **“Shipment”** tab: how much was ordered, how much is already shipped and how much is in the product warehouse. Enter the quantity and click “Ship” — partial shipments are possible. Only accepted products can be shipped. Details — in “Shipment to the customer and documents”.
5. **Archive.** When a specification is fully shipped, its orders and the specification go to the archive. They don't clutter working lists but remain in reports and traceability.

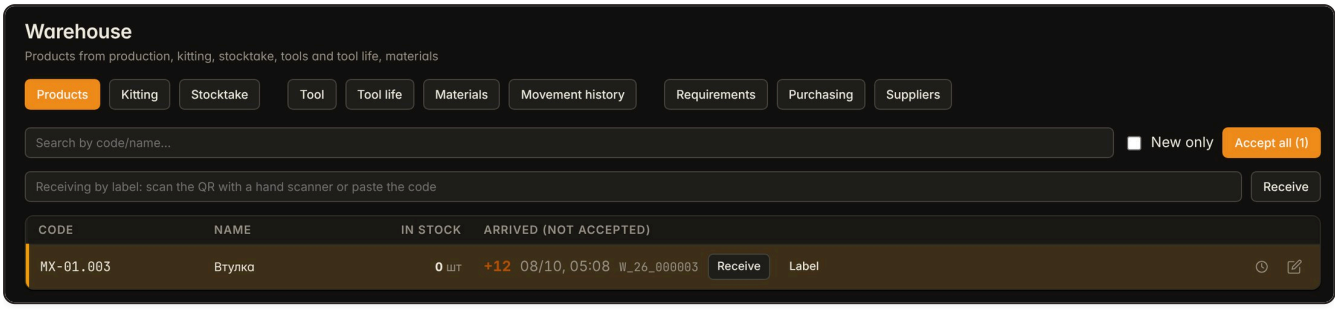


Fig. 26. Warehouse → “Products”: receipts awaiting acceptance

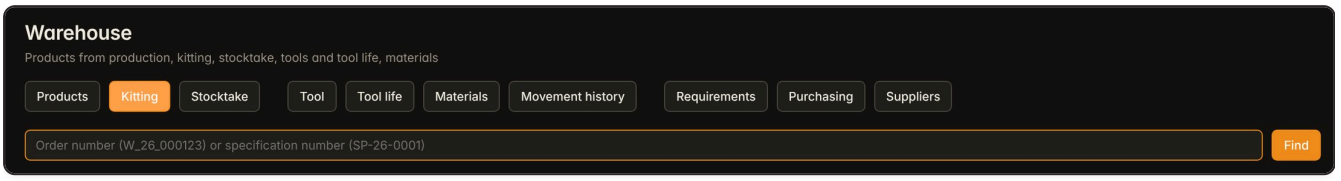


Fig. 27. Warehouse → “Kitting”: what the assembly needs and what is already in stock

12 STOREKEEPER · FOREMAN

Shipment to the customer and documents

Shipment closes the order for the customer: what was shipped, when and with which documents.

1. **Where we ship from.** Only from the product warehouse — what the storekeeper accepted after the last operation. Until a product is accepted, the “Ship” button won't let you send more than is in stock.
2. **How to ship.** Order card → **“Shipment”** tab → quantity → “Ship”. You can ship in parts: each shipment is a separate document with its own number.
3. **Documents.** Each shipment has two buttons: **“Delivery note”** (what, how many, to whom) and **“Passport”** (the batch passport: products, material, drawing, part numbers or serial numbers and the QC acceptance mark). The document opens in a separate window with a “Print” button — print it or save it as PDF.
4. **Order status.** When everything is shipped, the order gets the “Shipped” status and leaves the working lists.
5. **Log.** Orders → **“Shipments”**: all shipments by date, customer and document number. A wrong shipment can be cancelled — the products return to the warehouse.

> Rule: print the delivery note at the moment of shipment, not “later”. The document number and date are fixed by the software — paper and records will match.

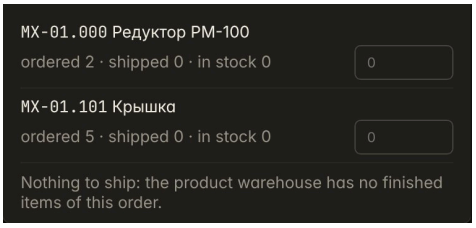


Fig. 28. Order card → “Shipment”: ordered, shipped, in stock; delivery note and passport for each shipment

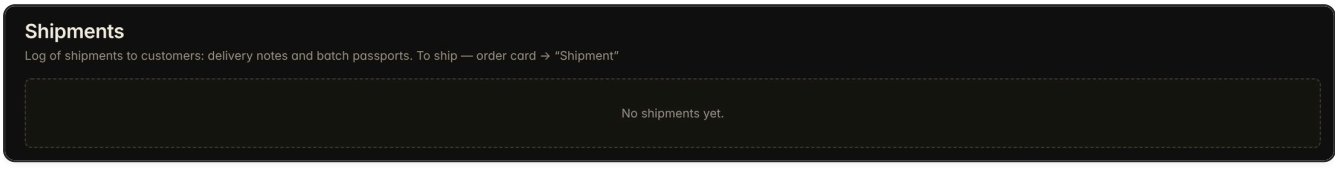


Fig. 29. Orders → “Shipments”: shipment log with documents

13 MANAGER · SALES

Quotes: price and lead time before the order

The “Quotes” module answers the customer's question “how much and when” before an order exists.

1. **Create a quote.** Orders → **“Quotes”** → new quote: customer, lines (a part or assembly from the item master, quantity). You can also type your own line — delivery, fixtures, purchased parts.
2. **The price is calculated automatically** from the routing: labor — at work center rates (Run × quantity + Setup), material — by consumption rates and warehouse prices, for an assembly — its whole structure. “Other” (outsourcing, purchased parts) — manually. Price = cost × (1 + markup); if you need a specific unit price, type it in — then the markup is not applied.
3. **Lead time** is calculated from the current capacity load: “if started now”. It is an honest lead time, not a wish.
4. **Send to the customer.** “Print” → a PDF quote with the company details. Status “Sent to customer”.
5. **Outcome.** The customer agreed — **“Create order”**: the order appears with all lines, nothing has to be re-entered. Rejected — mark “Rejected”: the quote list shows which offers win and which don't, and where the price doesn't suit customers.

> If the price looks odd, check the routing and WC rates. An error in a quote is almost always an error in the standards, and it should be fixed in the item master, not in one quote.

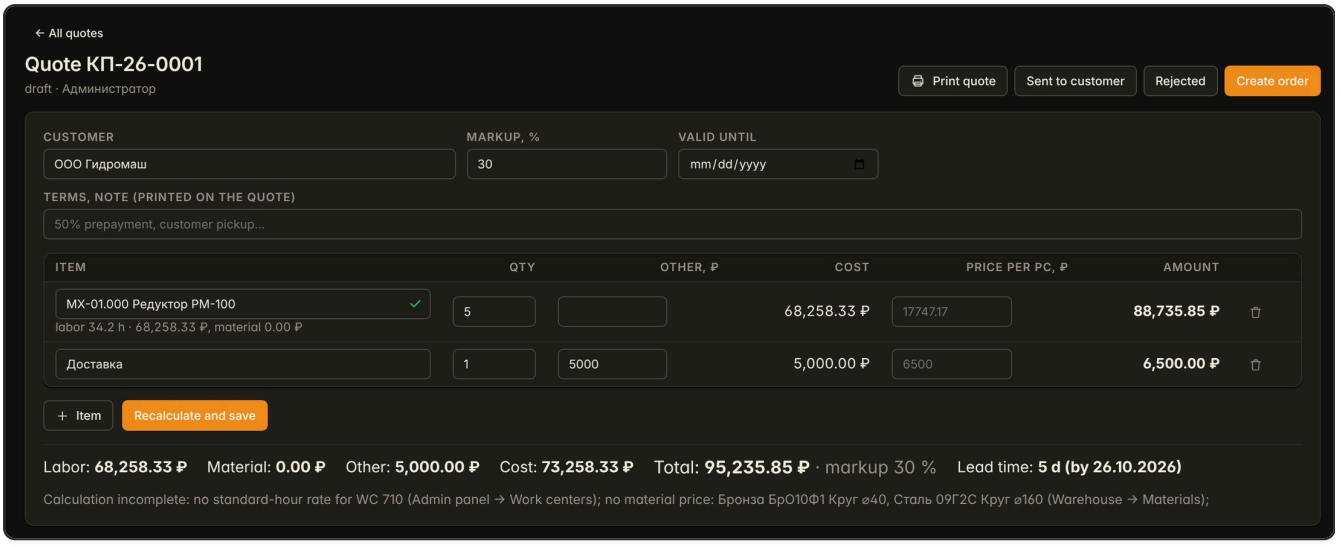


Fig. 30. Quote: items priced by routing, cost, markup, lead time by load; “Print” and “Create order”

14 FOREMAN

Shift plan, batch split and alternative WCs

The **shift plan** (Shop floor → “Shift plan”) lays out each machine's queue over the shift: what, at what time and how many to make.

1. Choose the date and shift (day/night). Under each WC — the shift load in percent: over 100% means the work doesn't fit.
2. Marks in a row: **“waiting for the previous operation”** — the previous operation hasn't handed in anything yet; **“→ next shift”** — doesn't fit into this shift; **“due!”** — the estimated finish is later than the order's due date.
3. The ↑ ↓ arrows change the order — the operator sees the same order in “My tasks”.
4. The ⇆ button moves an operation to another WC. **Alternative WCs from the routing** are offered first — the process engineer specifies in advance on which machines the part can be made.
5. **“Print”** — the WC plan for the shift as a sheet for the machinist, if the machine has no terminal.

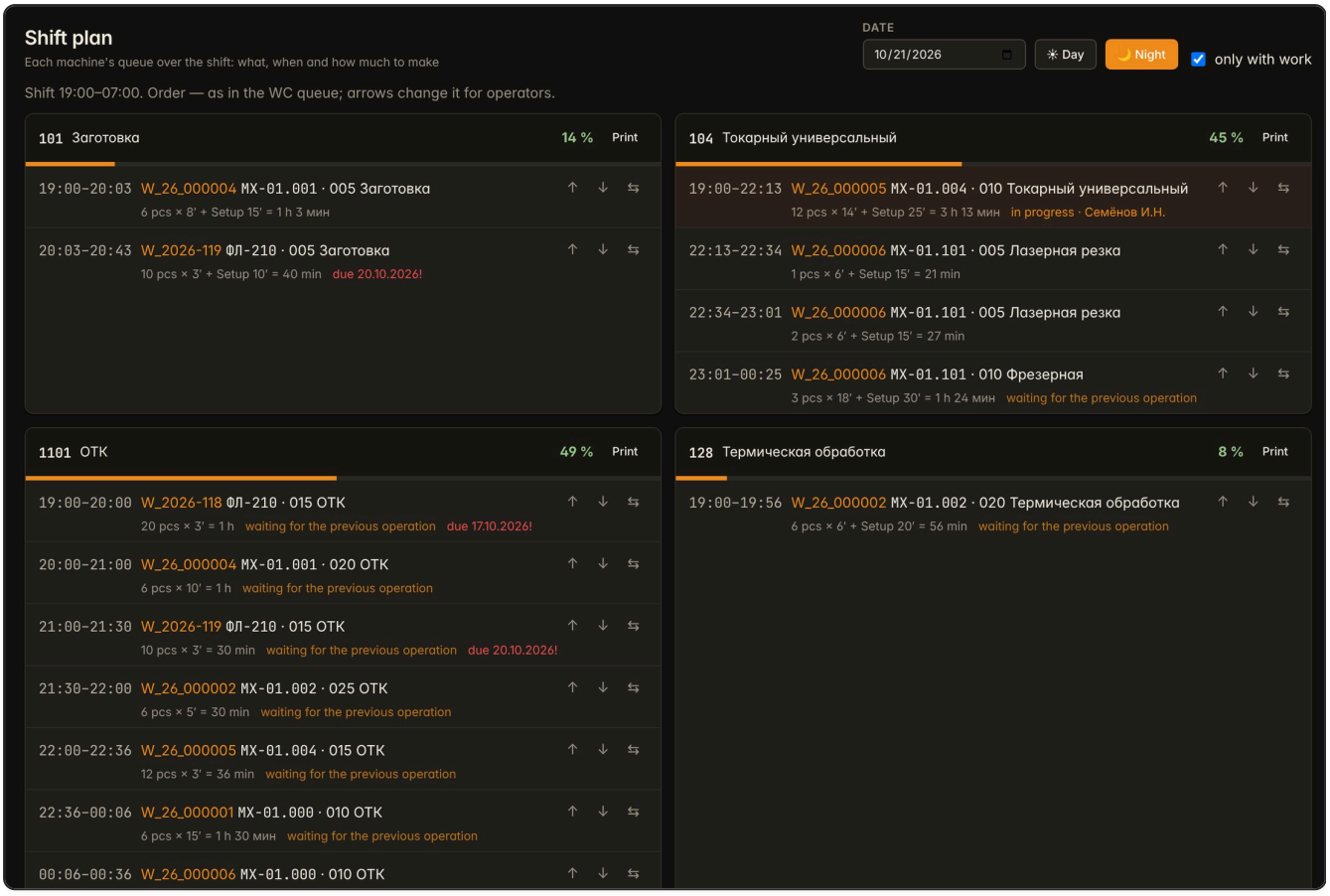


Fig. 31. Shift plan: each WC queue by time, shift load, “waiting for previous operation” and “due!” marks

Batch split. If the batch is large and a free machine is nearby — in the order card the operation has a **“Split batch”** button: enter how many parts go to which WC as a separate task. Both parts run in parallel, hand-ins are counted for each, and the order sees the total.

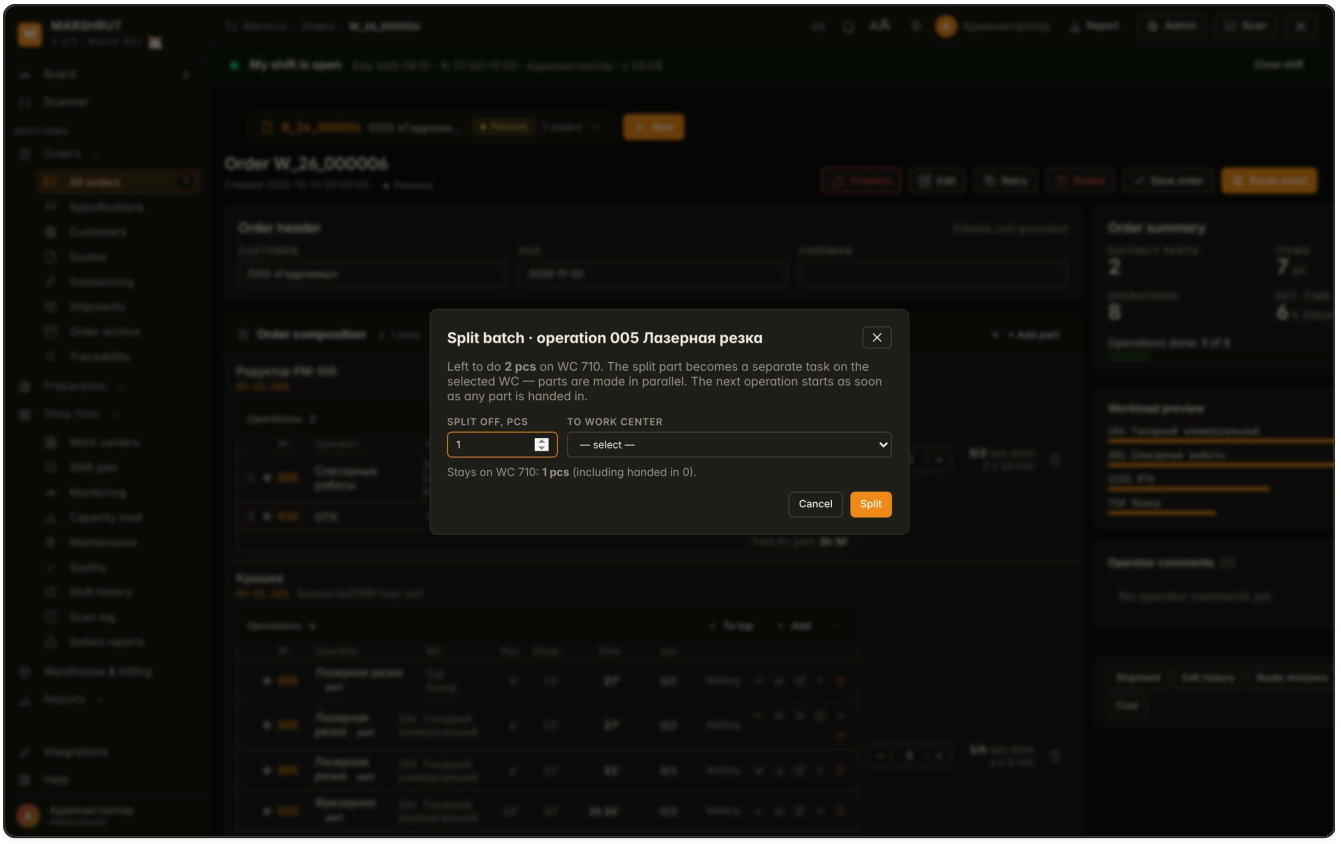


Fig. 32. Split batch: part of the parts as a separate task on another WC; alternative WCs from the routing first

> Rule: split a batch when it shortens the order's lead time, not “to keep everyone busy”. Every split adds a setup.

15 FOREMAN · PURCHASING

Outsourcing: operations at external suppliers

Heat treatment, plating, external grinding — everything not done by your shop must also be visible in the route.

1. **Send.** In the order card the operation has a **“Send to outsourcing”** button: supplier, quantity (part of a batch is possible), return date, price, comment (contract number, requirements).
2. **While at the supplier** the operation isn't in the shop queue, and the order shows “outsourced”. Orders → **“Outsourcing”**: what was sent, to whom, how many and by when; overdue ones are highlighted.
3. **Receive.** The **“Receive”** button: good and defective parts. Good parts go to the next operation as if your own operator had handed them in. If fewer came back and the rest won't return — “close the shipment”.
4. The outsourcing cost goes into the order cost.

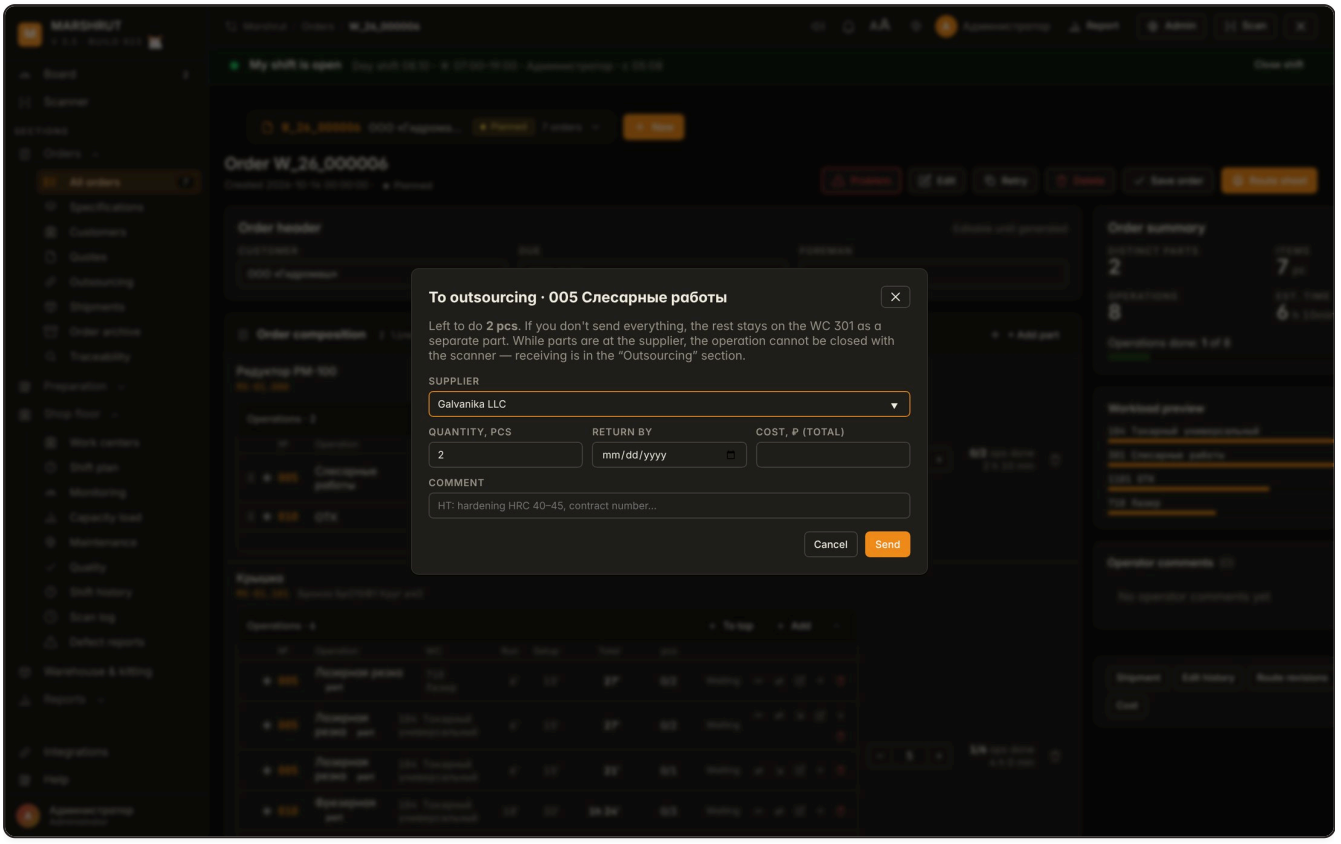


Fig. 33. Send an operation to outsourcing: supplier, quantity, date, price



Fig. 34. Orders → “Outsourcing”: who has what, return dates, acceptance

16 PROCESS ENGINEER

Design revisions: changes to drawings and routings

A part changes: a different tolerance, a new operation, a new material. It is important that the shop works to the current version and orders already started don't break.

1. The process engineer edits the routing in the item master as usual. Changes since the last revision are visible in the part card.
2. When the changes are ready — **“Issue change notice”**: briefly, what changed (“Ø40 tolerance changed, inspection operation added”). The revision number grows, and the history keeps the difference between revisions.
3. The software shows **open orders on the old revision**, and a warning appears in the card of each such order. Decide on each: **“Apply”** — not-yet-started operations of the part are updated per the new routing (started and closed ones don't change); **“Keep old”** — the order is finished on the old revision.
4. The revision goes into the route sheet and the batch passport.

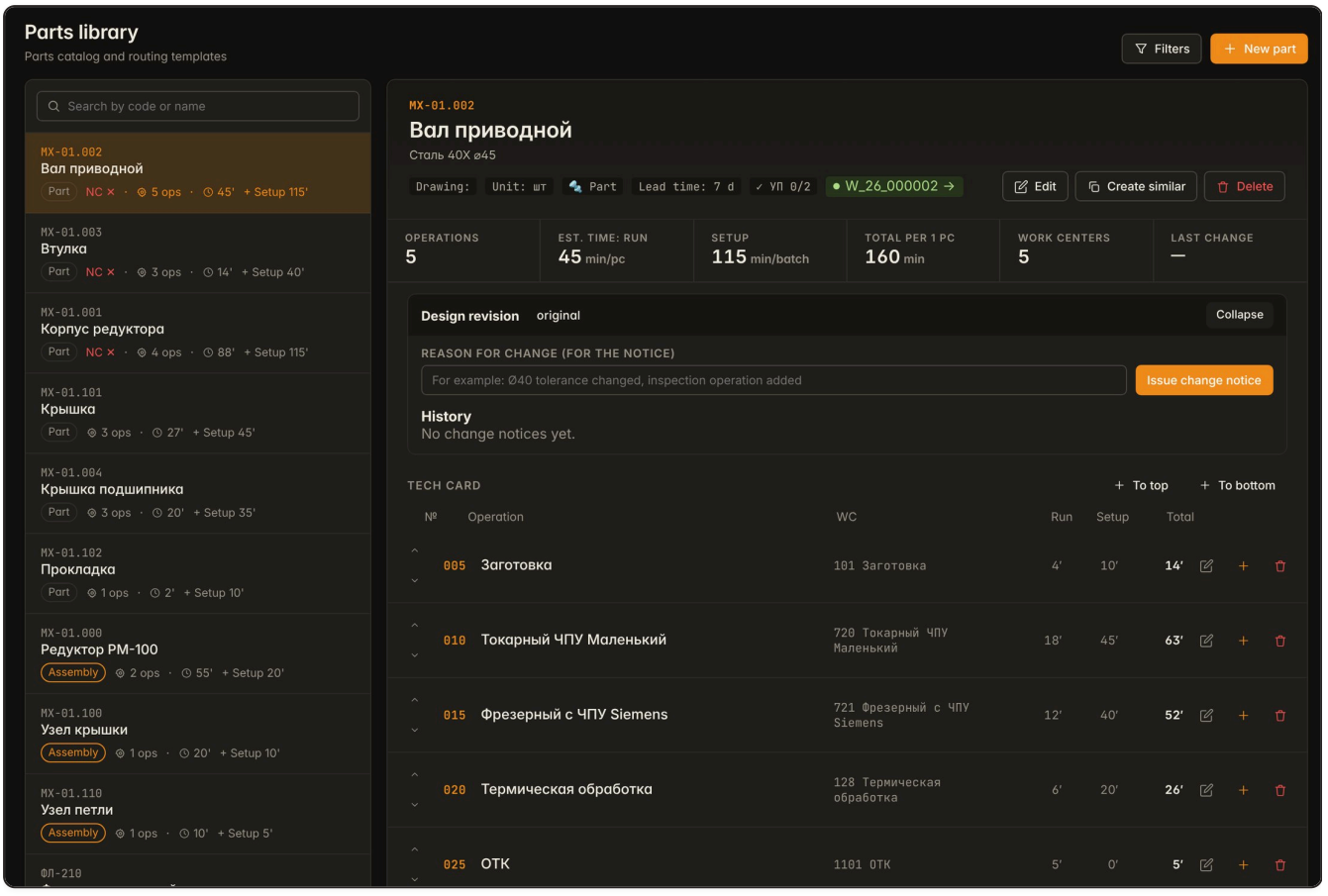


Fig. 35. Item master → part card: revisions, change notices and orders on the old revision

17 STOREKEEPER · ENGINEER

Stocktake and tool life

Stocktake (Warehouse → “Stocktake”):

1. Choose what you are counting: materials, tools or products. The document includes all items with book stock at the start.
2. Enter the actual count for each item — in several sessions if needed; “Save” keeps a draft. Surpluses and shortages are visible immediately.
3. **“Post”** — the difference is applied to the current stock. Movements made during the count are not lost: only the discrepancy is adjusted.
4. **“Print report”** — the stocktake report for signing.

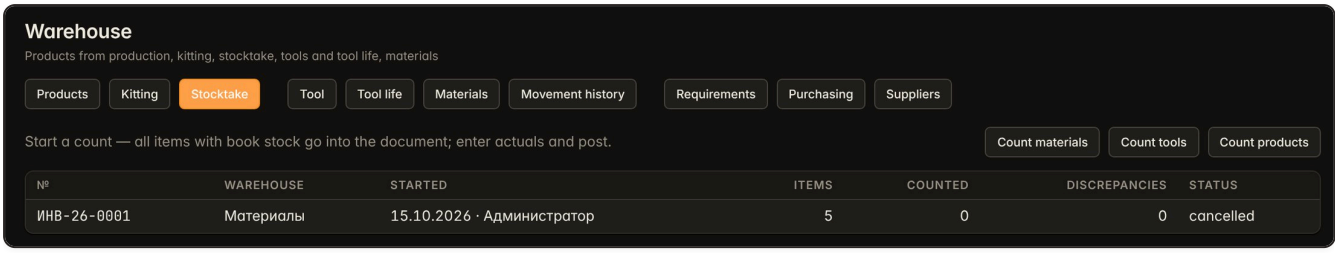


Fig. 36. Warehouse → “Stocktake”: recount of materials, tools or products

Tool life (Warehouse → “Tool life”):

1. For a tool item set its life — in parts or cutting minutes.
2. Operating time accumulates automatically when parts are handed in for operations the tool is linked to (in the routing or in the T01/T02… sequence), separately for each machine.
3. From 90% — “replace soon”, from 100% — “replace now”. The foreman and storekeeper see it in advance, not after a breakage.
4. Replaced it — **“Replaced”**: operating time resets, one piece is written off from the warehouse.

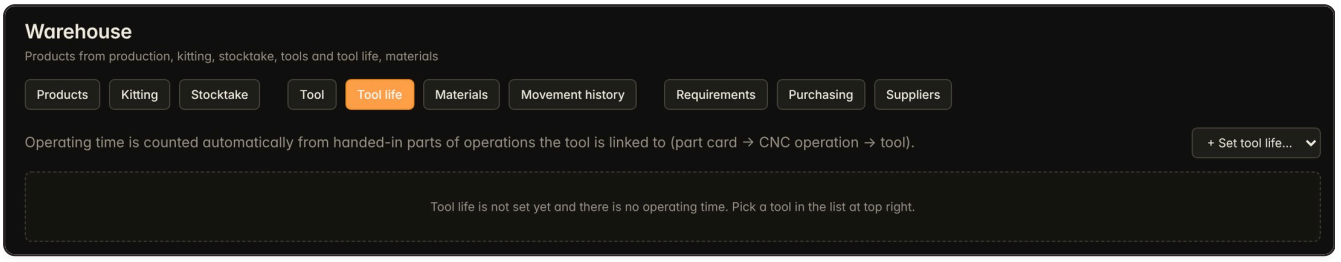


Fig. 37. Warehouse → “Tool life”: operating time by machine, “replace soon” and “replace now”

18 ADMINISTRATOR

Modules, license and AI assistant

The software consists of modules. Plans: **“Basic”** (routings, assemblies, design revisions, orders, WC queues, shift plan, batch split, alternative WCs, outsourcing, QR scanner, shifts, board, time standards control, shipments), **“Production”** (+ warehouse and CNC tech prep, quality, analytics, quotes) and **“Full”** (+ maintenance, 1C, access control, traceability, AI assistant). There are no limits on the number of work centers or users.

1. Admin panel → **“Features”**: the list of modules with switches. A module with a lock is not included in the license — the vendor adds it.
2. Admin panel → **“License”**: which modules are included and until when. The license file is signed — it cannot be edited by hand.
3. The **AI assistant** is a separate module. Admin panel → “AI assistant”: on/off, key, model, daily limit, connection test and usage. Permission to use the assistant is granted by role.

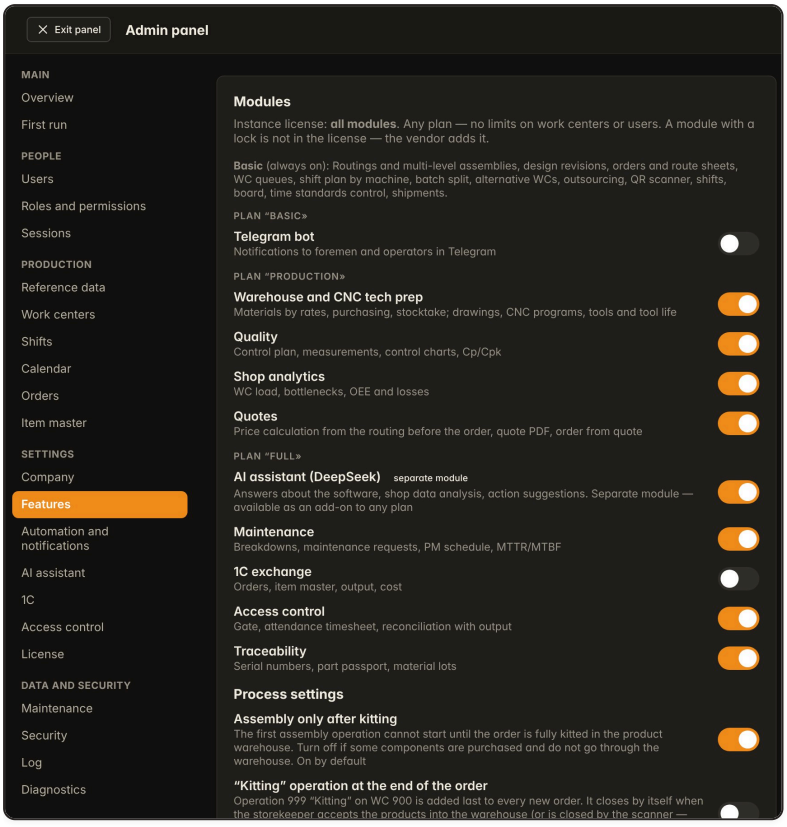


Fig. 38. Admin panel → “Features”: modules by plan; with a lock — not in the license

4. How to use it: the **“Assistant”** button in the bottom-right corner. Ask in your own words: “which orders are urgent”, “why is 104 idle”, “how do I record outsourcing”. The assistant answers from the manual and shop data and can **suggest an action** with a “Run” card — you run it yourself, with your permissions, and see exactly what will be done. When the interface is in English, the assistant answers in English.

> The assistant is a hint, not the shop manager. The decision and the responsibility stay with the person.

19 FOREMAN

Foreman: the daily cycle

When	What to do	Where
Morning, before the shift	Check overdue and urgent orders, readiness of programs and material	Board, Orders
Morning	Arrange the **queue for each WC** in the right order (by dragging)	WC queue
Morning	Check overloads in hours and move tasks to free WCs	Capacity load
During the shift	React to **problems** and long pauses, close them with a comment about the solution	Board, Telegram
During the shift	Decide when less is handed in: finish later or close at N	Order card
When needed	Add or edit an operation in an order (to top, in between, ✎). Only unclosed operations can be changed	Order card
End of shift	Compare plan/actual Setup/Run, read shift handovers, close forgotten shifts	Time standards, Shift history, Admin panel → Shifts

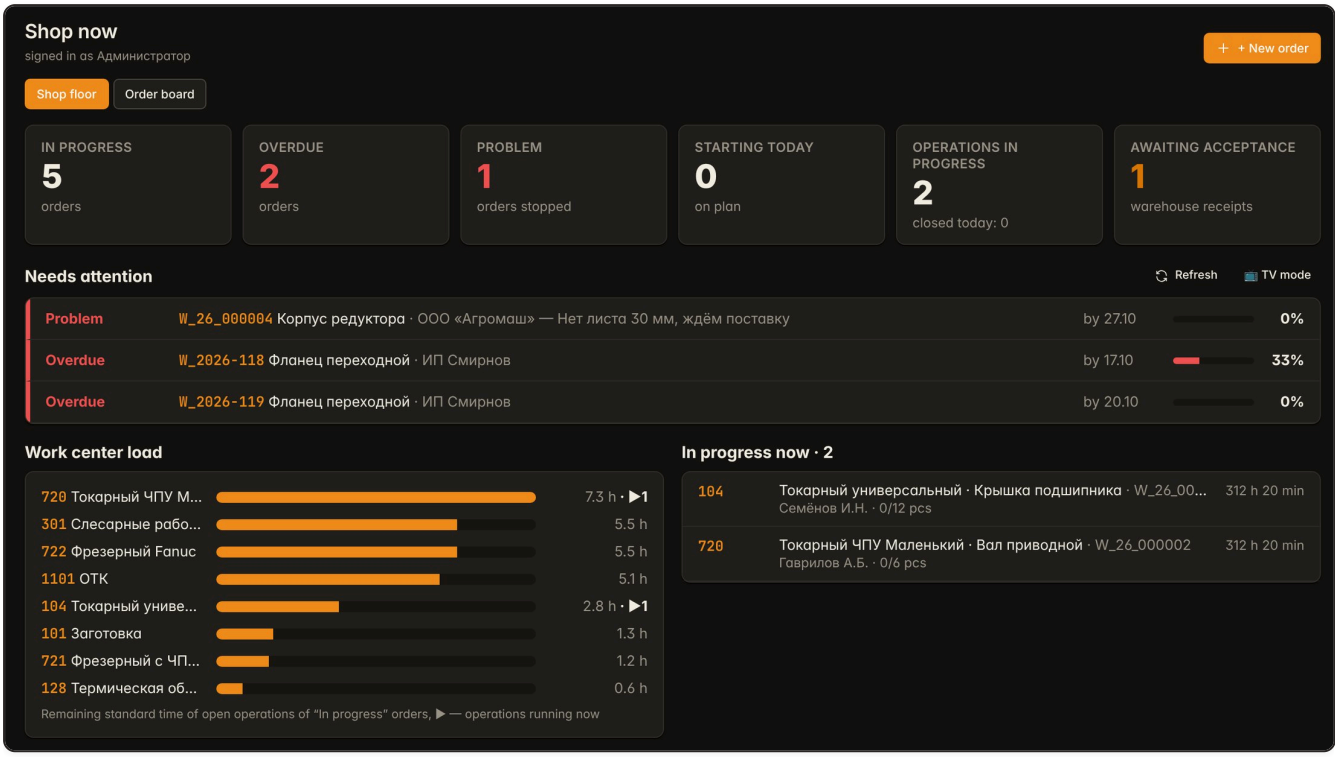


Fig. 39. Board: orders, problems, WC load and what is in progress now

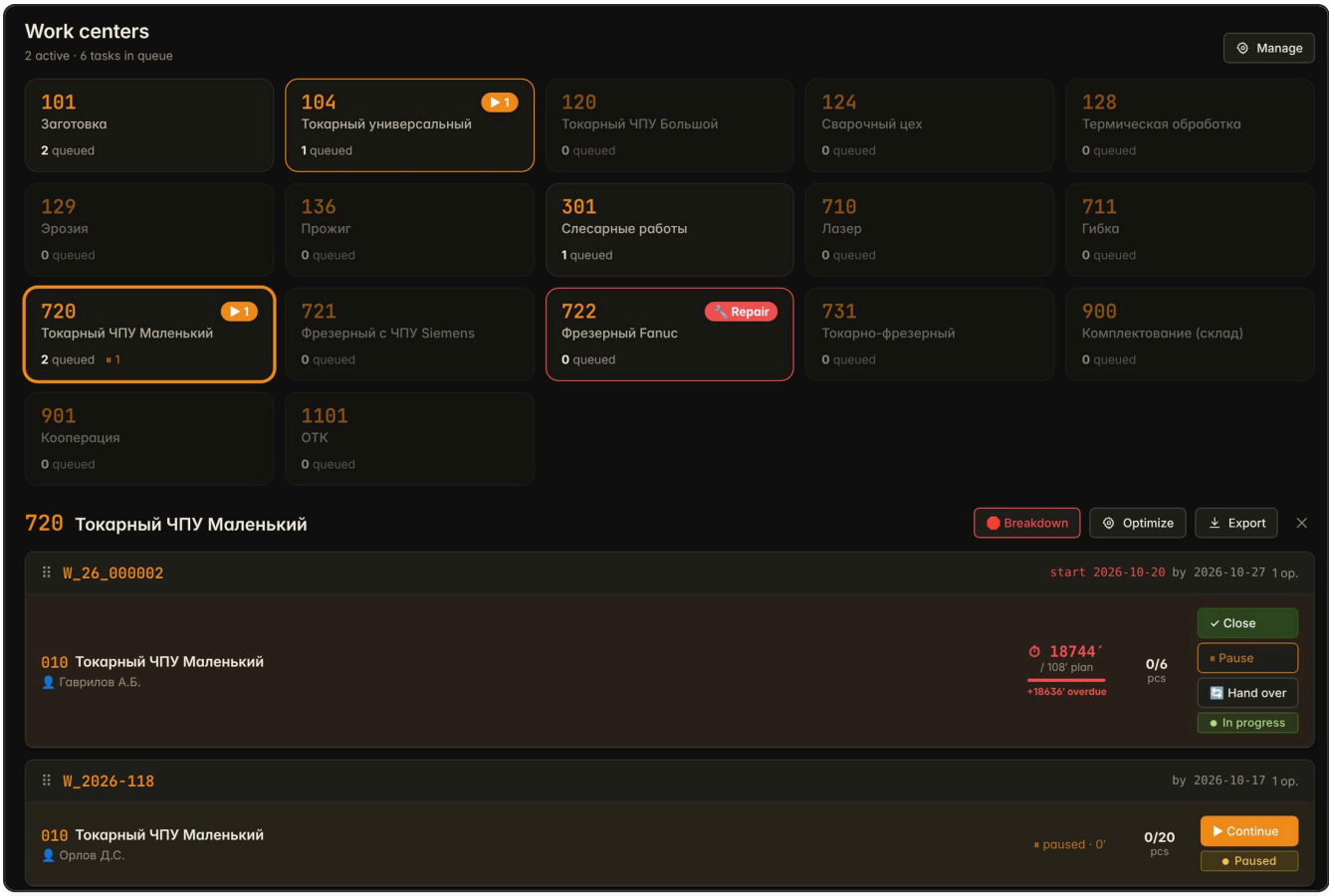


Fig. 40. Work center queue: reorder by dragging, actions for each operation

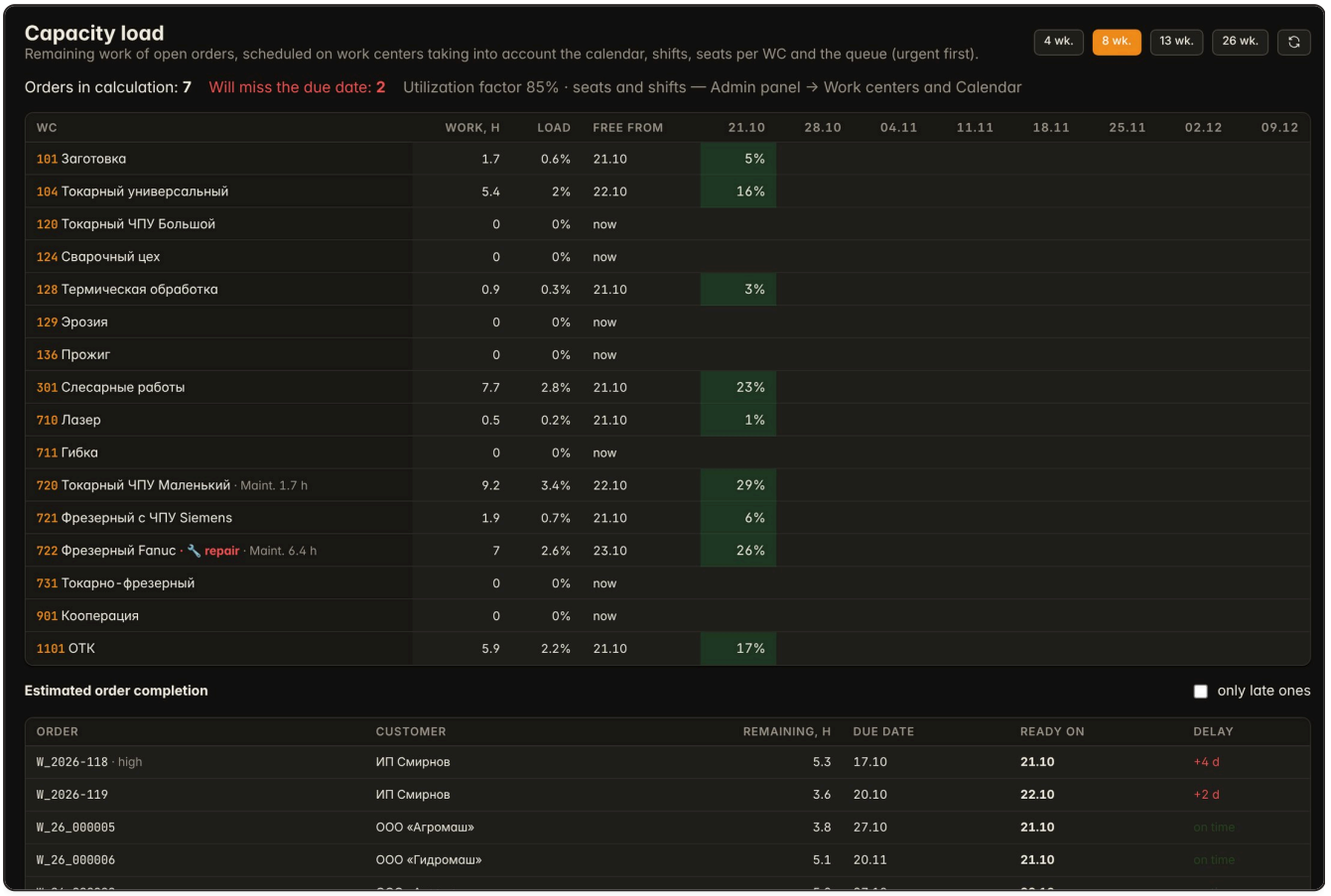


Fig. 41. Capacity load: hours by WC for weeks ahead and estimated order completion

If actual time keeps differing from the plan, the time standards in the routing need correcting (Step 1). New orders will take the new standards.

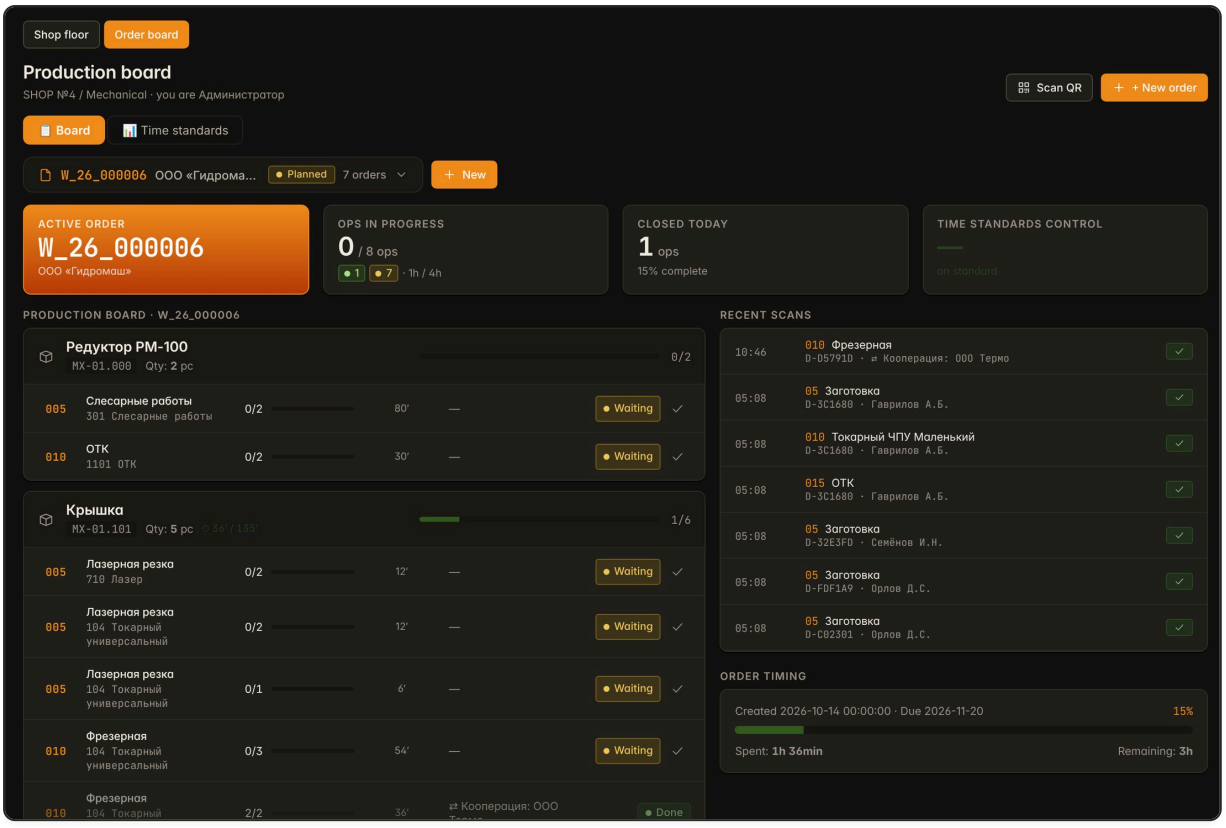


Fig. 42. Order board: the active order, operations by part and the latest scans

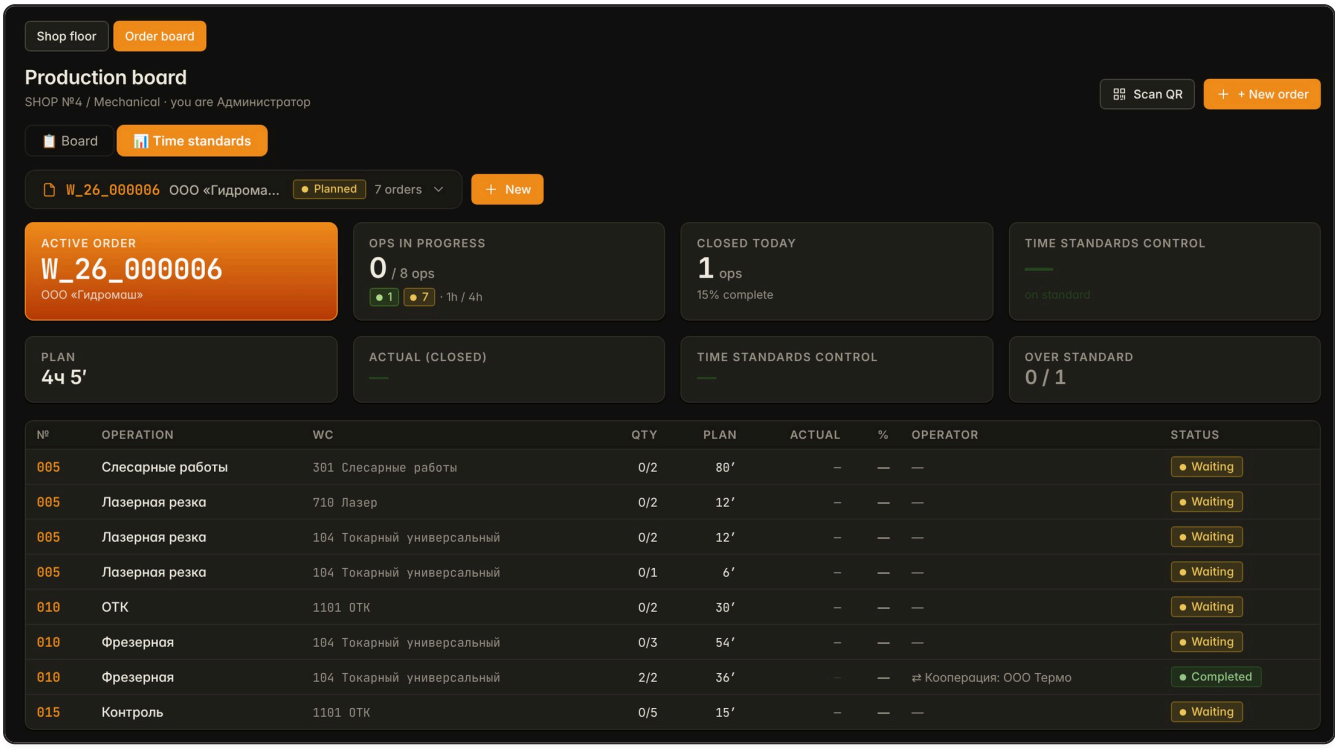


Fig. 43. Board → “Order board” → “Time standards”: plan and actual for each operation, overruns highlighted

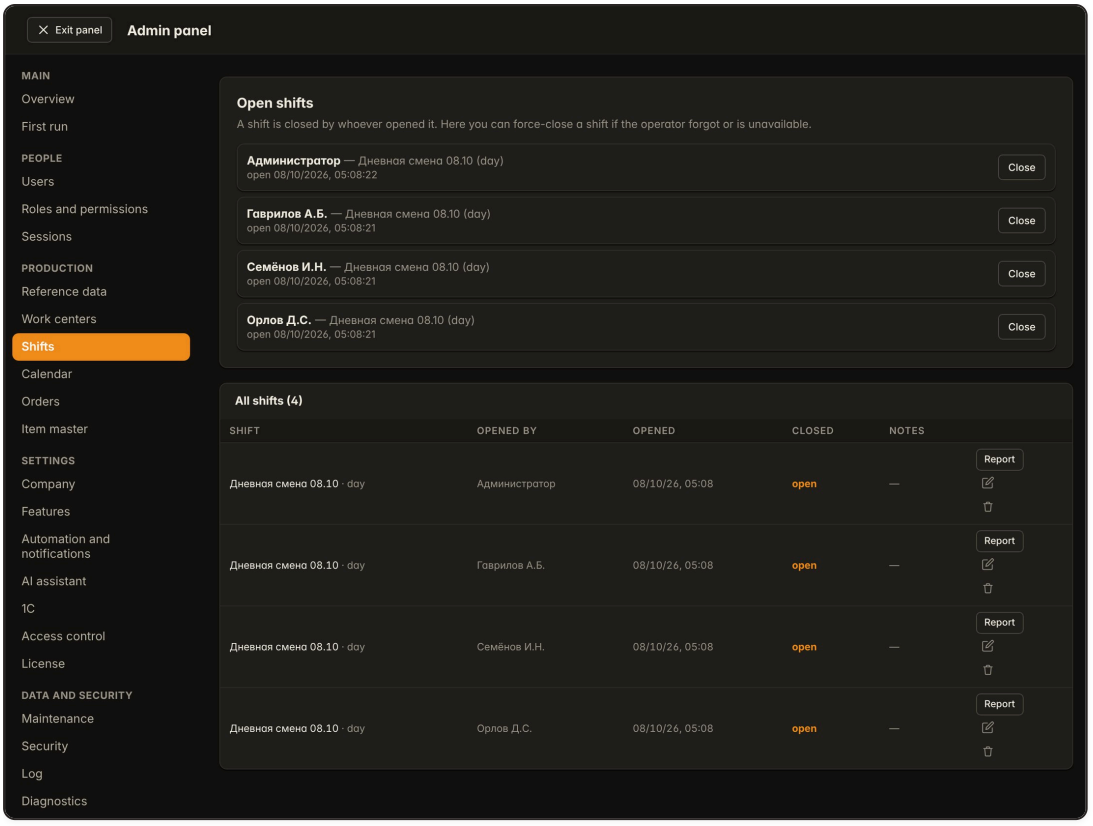


Fig. 44. Admin panel → “Shifts”: unclosed shifts — close a forgotten one with one button



Fig. 45. Shift history: who worked on which orders and operations during the shift

20 MAINTENANCE

Maintenance: breakdowns and planned repairs

The module is turned on in **“Features”**.

1. **Breakdown.** The operator presses “Breakdown”. A request is created, the machine is marked as down, and technicians are notified.
2. **Repair.** The technician takes the request, writes what was done and which spare parts were used, and closes it. The machine is available again.
3. **PM.** In the equipment card set a preventive maintenance schedule (by date or by operating hours). The system creates the jobs on time.
4. Plan PM taking the load into account: downtime reduces the WC's available capacity.
5. The history of breakdowns and downtime for each machine is visible in the reports.

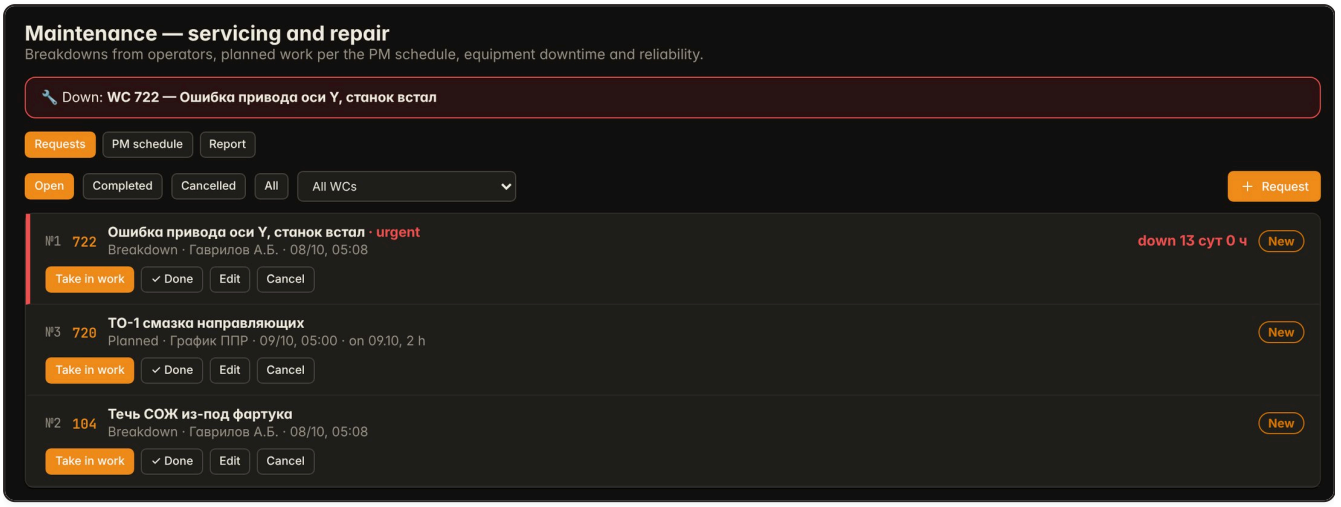


Fig. 46. Maintenance → “Requests”: breakdowns from operators and planned work

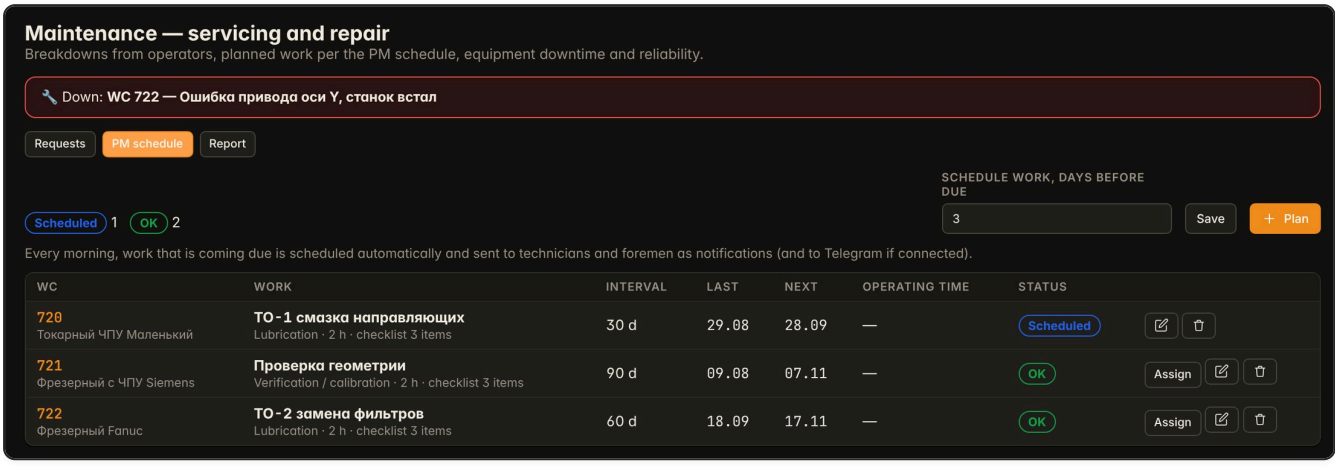


Fig. 47. Maintenance → “PM schedule”: interval, next date, state

21 MANAGER

Reports, analytics, access control and 1C

- **Reports**: output by person and WC, plan/actual Setup/Run/Total, defects, downtime and its causes, piece-rate pay by rates. Printed and exported to Excel.
- **Analytics**: equipment load, order lead times, bottlenecks. The figures are honest only if operators record their actions on time.
- **Traceability**: by order number or lot you see who made the part, on which machine, from which material and with which measurements, and to whom it was shipped.

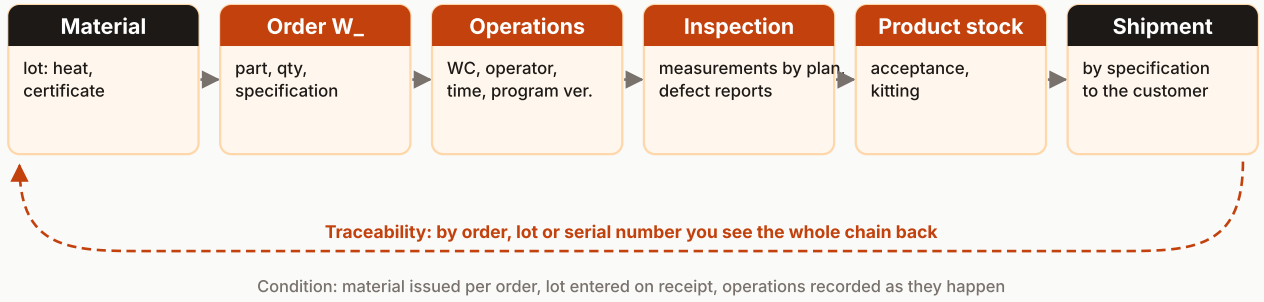


Diagram 5. Traceability: from a material lot to shipment

- **Access control** (turned on in “Features”): badge passes and a timesheet. Useful for comparing time on site with time on shift.
- **1C** (turned on in “Features”): exchange of the item master, material movements and output. Agree **where the catalog is kept** (in the MES or in 1C) so the same thing isn't edited in two places.
- **Telegram**: notifications to the foreman and manager about problems, breakdowns and overdue items.

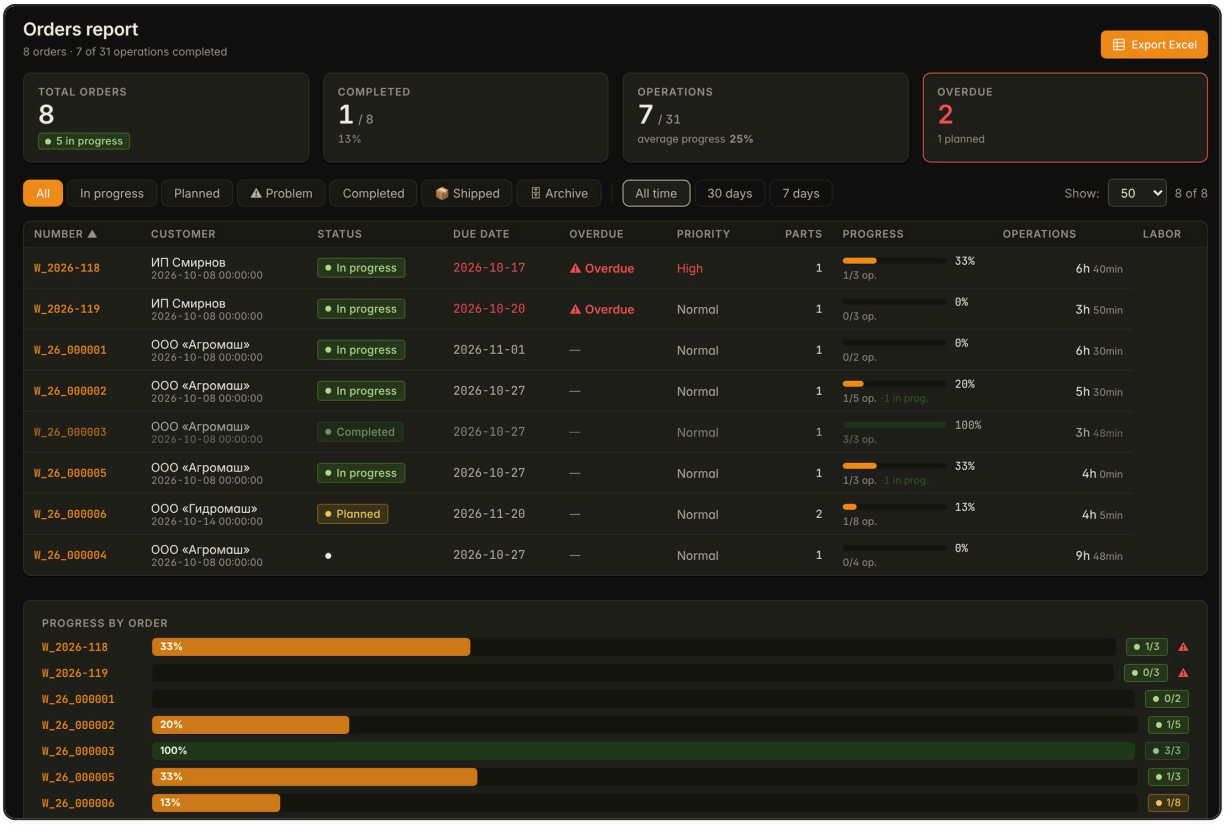


Fig. 48. Order report: statuses, progress, labor, export to Excel

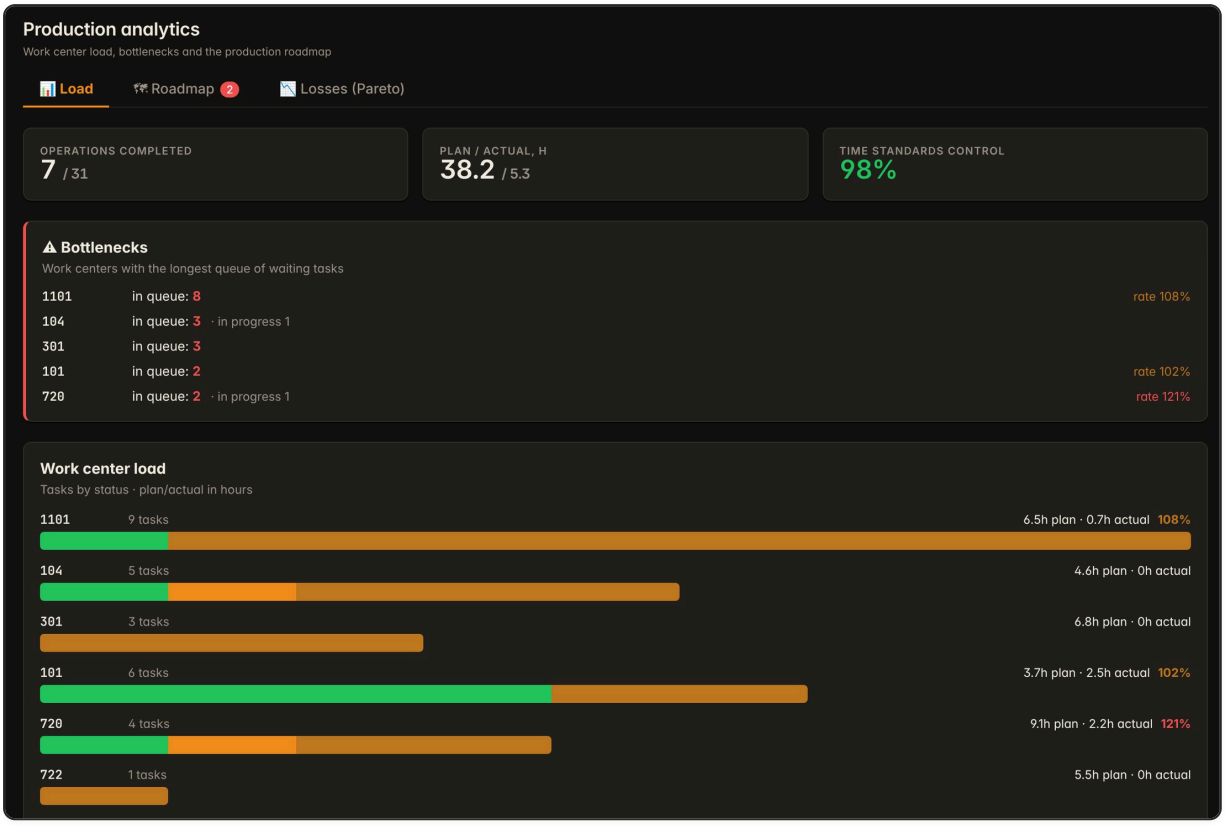


Fig. 49. Analytics: bottlenecks and WC load plan/actual



Fig. 50. Analytics → “Roadmap”: all orders on a timeline, color — state and overdue

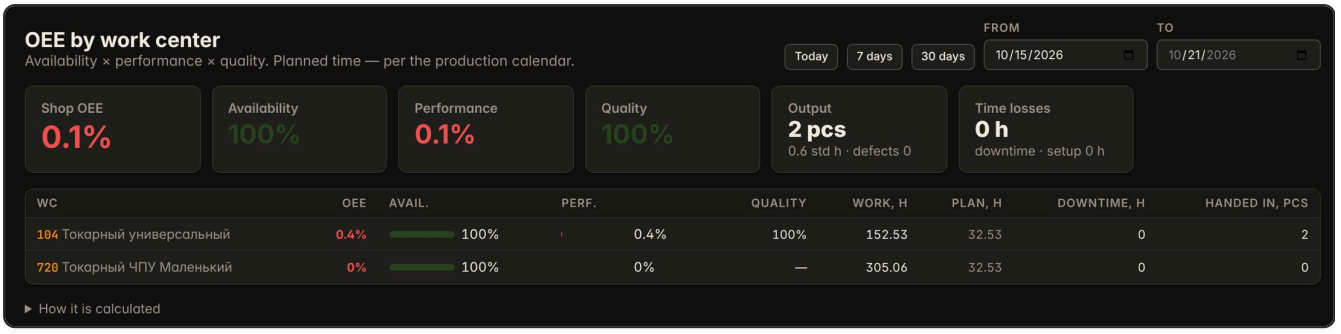


Fig. 51. Reports → “OEE by WC”: availability, performance, quality and downtime

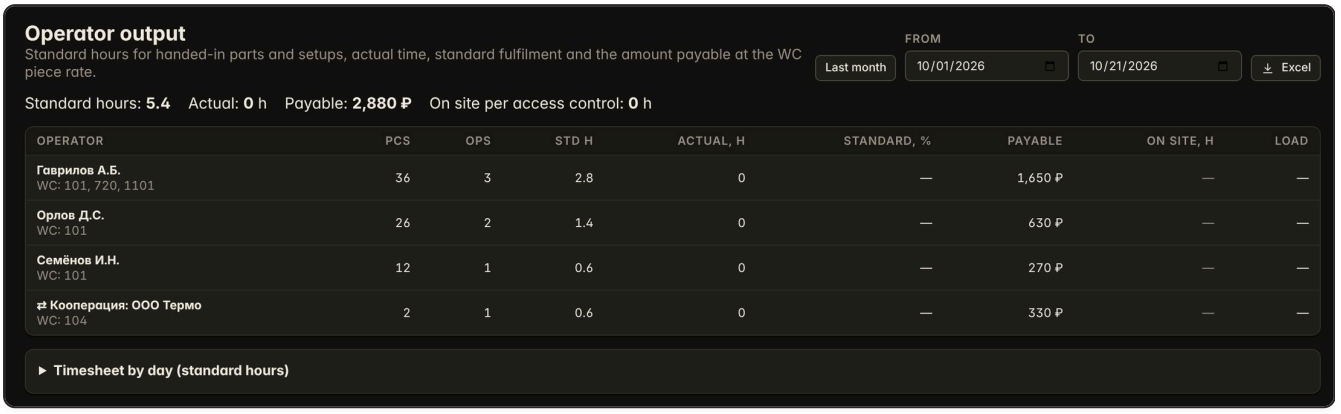


Fig. 52. Reports → “Labor output”: standard hours, parts made and pay by operator

22 ADMINISTRATOR

Administrator: keeping the system stable

1. **Backups.** Check once a week that automatic backups are being made. Keep a copy off the server. Always make a manual backup before an update.
2. **Users and permissions.** A role is given by job title; keep administrators to a minimum. **Block** people who have left immediately (their work history stays) and unlink their badge.
3. **Security.** Strong passwords for administrators, unique PINs for operators. Review the sign-in and activity logs.
4. **Diagnostics.** The diagnostics section shows the state of the database, disk, queues and integrations. Look there first if users complain.
5. **Reference data.** Keep pause, problem and defect reasons short and clear. Otherwise operators will pick “Other” and the analytics lose their meaning.
6. **Updates.** Do them outside the shift and only after a backup.

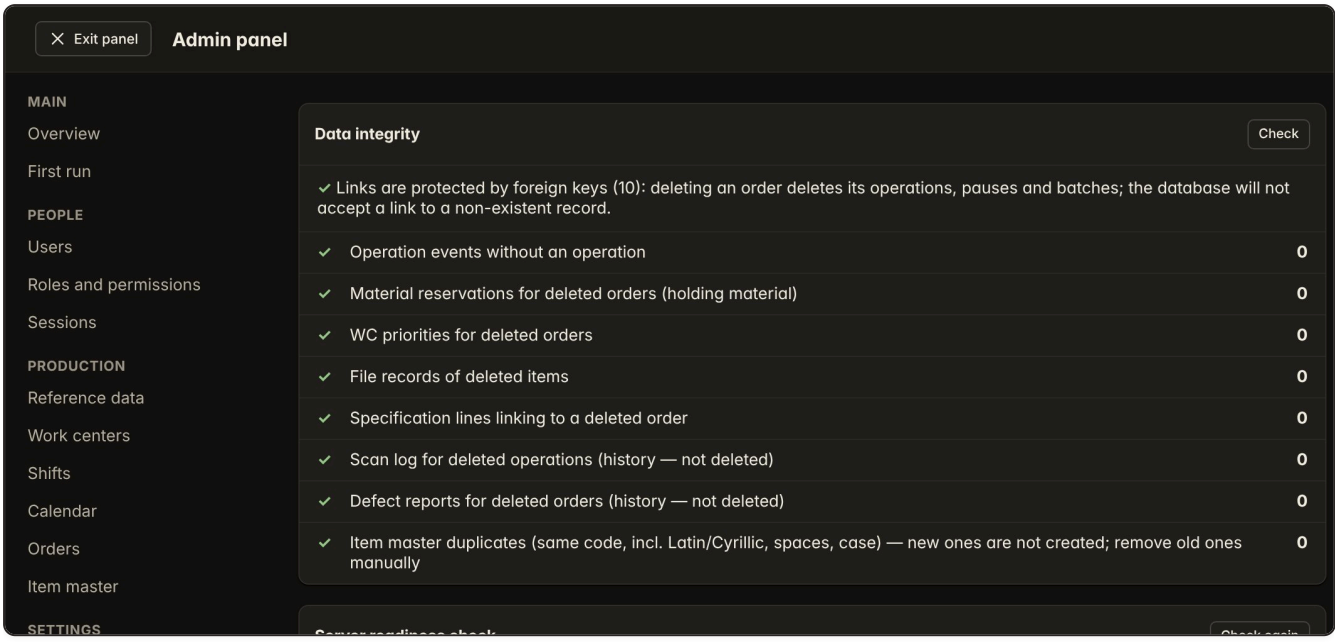


Fig. 53. Admin panel → “Diagnostics”: data integrity and server readiness

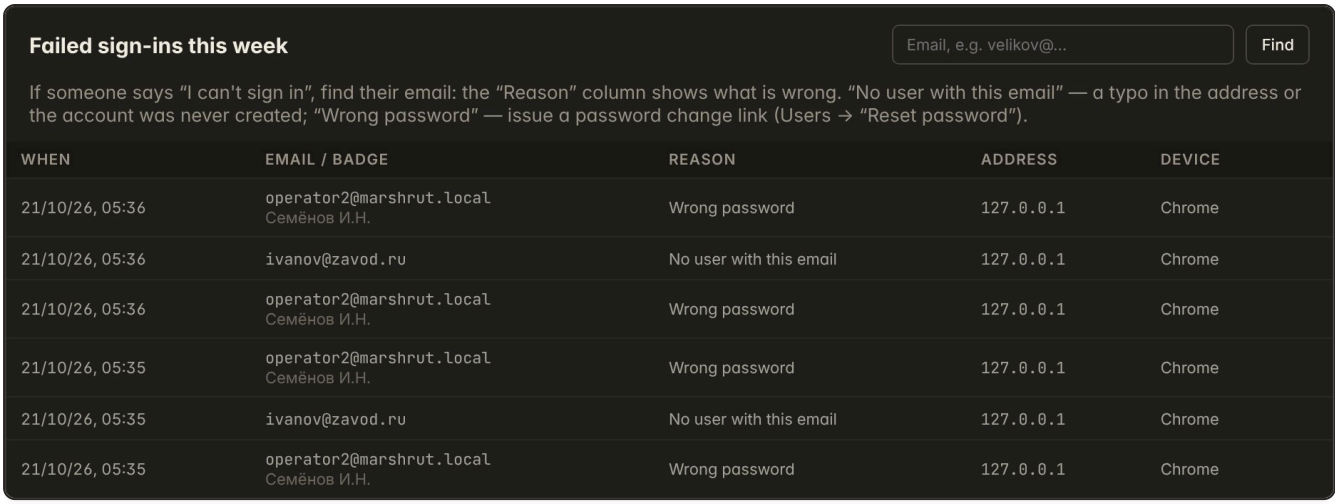


Fig. 54. Admin panel → “Security”: failed sign-ins with the reason — you see why a person can't sign in

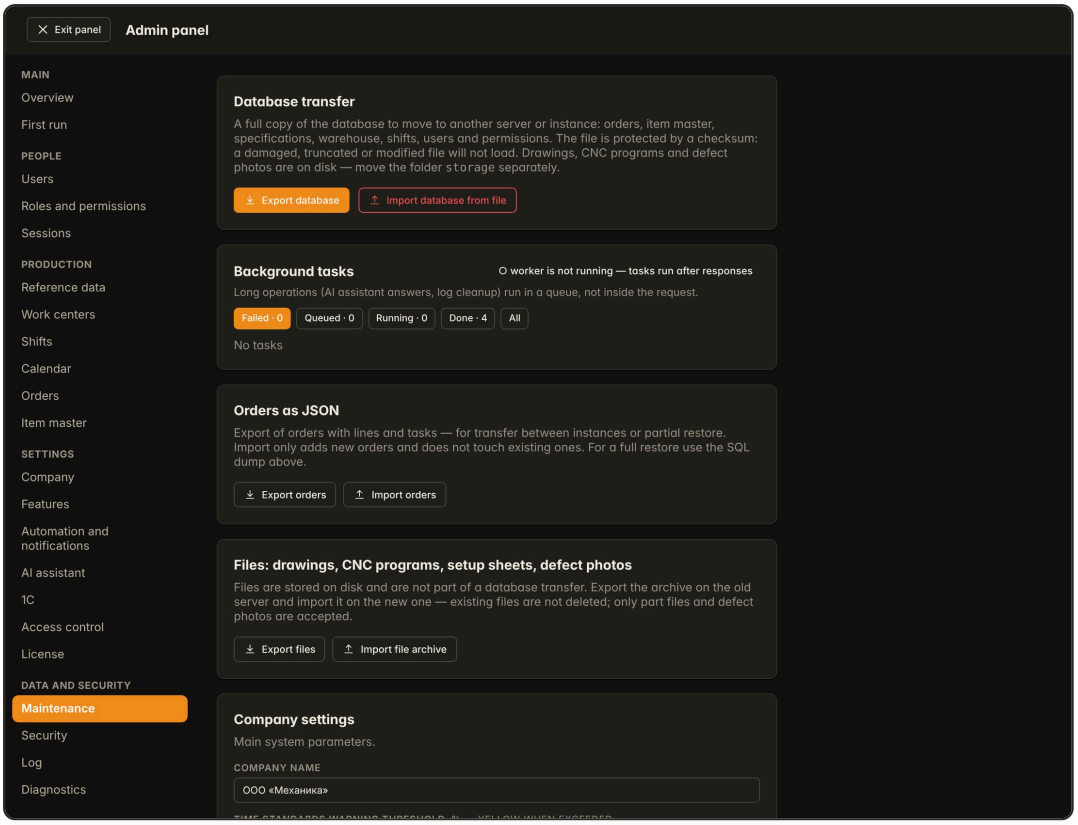


Fig. 55. Admin panel → “Maintenance”: database transfer, exports, time standards thresholds

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Rules for organizing production

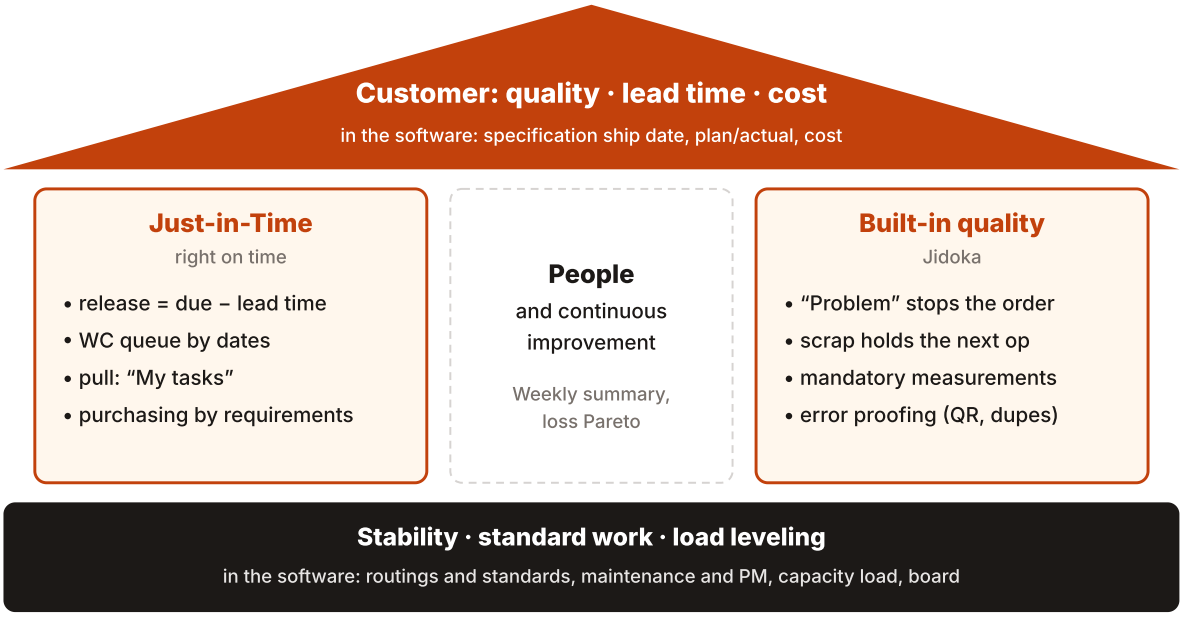
These are the basic rules any job shop or small-batch plant rests on. For each one — how to follow it in the software.

Rule	What it means	How in the software
Start by due date, not "whatever is convenient"	The order of work is set by the ship date and the product's cycle time, not by what is easier to make	Start dates are calculated automatically: start = due − lead time. The work center queue follows start dates by default
Don't start without a full kit	An order goes to the shop only when the drawing, CNC program, material and tooling are ready	Status "Waiting for material / equipment / approval" instead of "In progress". Before starting — Tech prep and Warehouse → Requirements
Limit work in progress	The more orders are open at once, the longer each takes	Keep "In progress" only what is really being made. The rest — "Planned". Watch the WC queue and "Capacity load"
Plan around the bottleneck	Shop output is set by the most loaded machine, not the average	"Capacity load" and "Analytics → Bottlenecks" show where the queue is. Load it first and never let it idle
The first part goes to inspection	A setup error found on the first part costs one part, not a batch	A control plan with "first part" frequency, no hand-in without required measurements (Quality)
Don't throw defects away silently	Every defect is information about a problem in the process	Defect at hand-in with a reason and photo, a defect report, the next operation waits for the foreman's decision
A changeover is an expensive operation	Identical parts are cheaper to make in a row	The "Optimize" button in the WC queue suggests an order with fewer changeovers. Actual setup is shown separately from run
A shift is handed over, not abandoned	The next shift must know the state of the machine and the batch	"Hand over shift" with a comment, "Hand in part" instead of closing an unfinished operation
Planned maintenance beats emergency repair	A machine that breaks suddenly ruins all due dates	Maintenance → PM schedule; PM time is taken into account in capacity load
A standard is an agreement	A standard must be achievable and revised based on actuals	Time standards control: actual vs standard by operation. A persistent deviation is a reason to revise the routing

24 MANAGER · FOREMAN

Lean manufacturing: the Toyota system and how to apply it in Marshrut

The Toyota Production System (TPS) is the basis of what is now called lean manufacturing. Its idea is simple: **make only what the customer needs, when it is needed, and without waste**, and make every problem visible and solve it at its cause. The system is often drawn as a house: the roof is quality, delivery and cost; the two pillars are “just-in-time” and “built-in quality”; the foundation is stability, standard work, leveling and continuous improvement.



The two pillars of TPS

- **Just-in-Time.** Each operation makes what the next one needs, in the right quantity and by the right time. Not earlier — otherwise stock and WIP; not later — otherwise a delay. *In the software:* backward scheduling from the ship date (start = due − lead time), a component's due date = the assembly start, order auto-start on the start date, WC queue by date, “Capacity load” with the estimated completion date.
- **Built-in quality (Jidoka, “autonomation”).** When there is a deviation, the process stops until the cause is removed — defects don't move on. *In the software:* “Problem” stops the order (starting operations is blocked), a defect blocks the next operation until the foreman decides, no hand-in without required measurements, “Assembly only after kitting”.

The eight wastes (muda) — where to see them in the software

Waste	Example in the shop	Where to see it	What to do
Overproduction	Made more or earlier than needed	Product warehouse: sits unshipped; orders started before the start date	Orders only from specifications, start by date; “Close at N” only by the foreman's decision
Waiting	A machine or person waits for material, program, QC, the foreman	Pauses and downtime by reason, “Analytics → Losses (Pareto)”, OEE availability	Tackle the biggest downtime cause first
Transport	Parts are carried between distant sections	The operation route in the routing	Revise the route, combine operations on one WC
Over-processing	Precision or an operation the customer doesn't need	Time standards control, extra operations in the routing	Remove from the routing, agree tolerances with the designer
Inventory	Excess material, WIP, parts “just in case”	Material warehouse, WC queues, product warehouse	Requirements by rates, purchasing for orders, limit “In progress”
Motion	Searching for a tool, drawing, program	Pauses “no tool”, “process engineer / approval”	Files, CNC program and setup sheet on the operation — the operator sees them at the machine
Defects	Scrap, rework	Defect reports, “Losses (Pareto)” by part and reason, Quality → analysis	First part to inspection, control plan, root cause analysis (5 whys)
Unused talent	The operator knows a better way but nobody asks	Operator comments in the order, problem reasons	Discuss suggestions at the meeting; adopted ones go into the routing

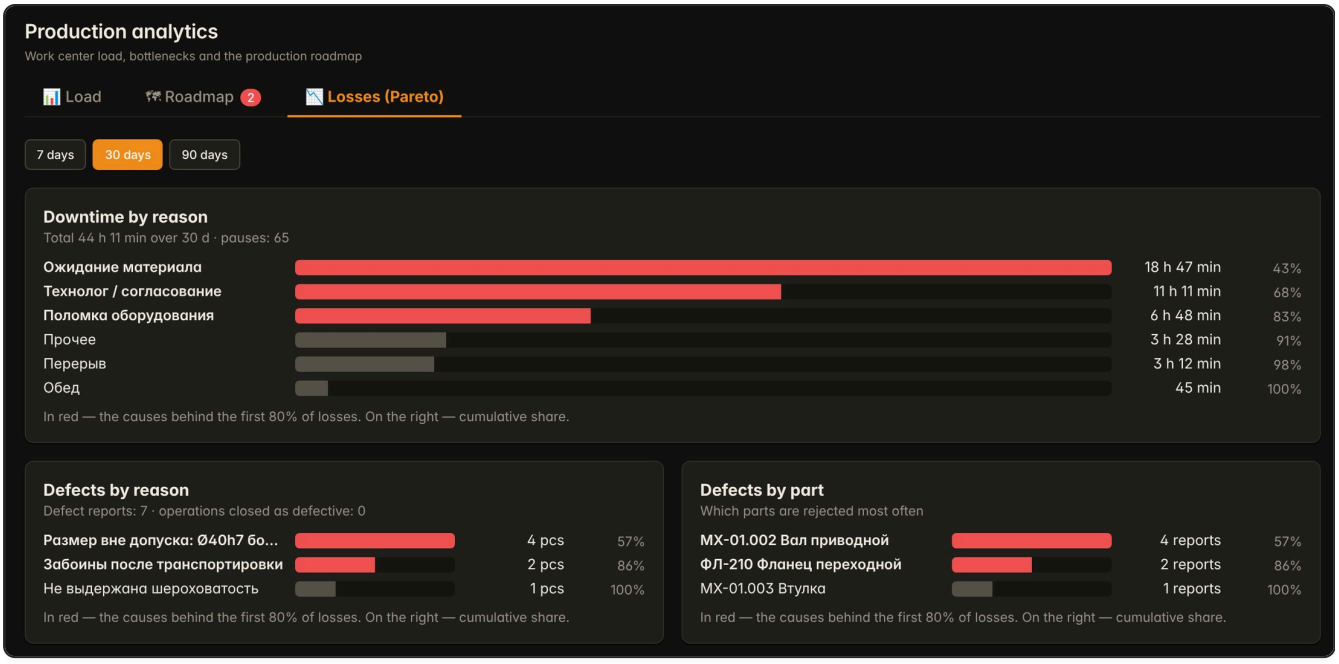


Fig. 56. Analytics → “Losses (Pareto)”: downtime and scrap by reason. Red — the causes behind 80 % of losses: start improvements with them

Besides waste, Toyota identifies **mura** — unevenness (a rush today, nothing to do tomorrow) and **muri** — overloading people and equipment. Both are visible in “Capacity load”: peaks by week and WCs above 100%.

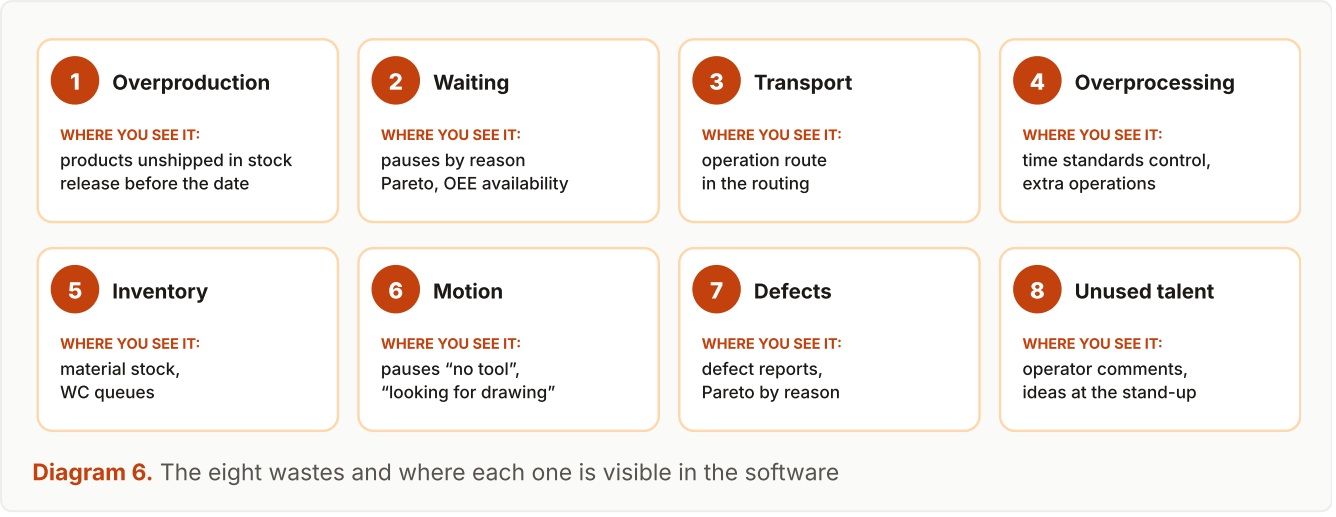


Diagram 6. The eight wastes and where each one is visible in the software

TPS tools and their place in the software

Tool	Essence	How to use it in Marshrut
Andon	A “I have a problem” signal everyone sees at once	The operator's “Problem” and “Breakdown” buttons → “Needs attention” on the board, a Telegram notification to the foreman
Poka-yoke (error proofing)	Make the error impossible rather than “be more careful”	No duplicate item codes, an operation QR code instead of picking from a list, no start under “Problem” or after a defect, required measurements, form checks

Tool	Essence	How to use it in Marshrut
Pull and kanban	The next stage “pulls” work from the previous one instead of having it pushed	WC queue and “My tasks”: the operator takes the next in line; warehouse → kitting for assembly; requirements → purchasing for real orders
Heijunka (leveling)	Even load without rushes	“Capacity load” by week, moving tasks to free WCs, shifting specification dates
Takt	The rhythm at which the customer “takes” products: available time ÷ demand	Available time — from the Calendar and shifts, demand — from specifications. Compare takt with the bottleneck's run time
SMED (quick changeover)	Cut setup time: prepare everything in advance while the machine is running	Actual setup separate from run, setups in OEE by WC, the setup sheet in the operation files, “Optimize” — fewer changeovers
TPM (total productive maintenance)	Equipment doesn't break because it is maintained to a plan	Maintenance: PM schedule by days and operating hours, requests from operators, MTBF and MTTR, downtime history per machine
Standard work	The best known way to perform an operation, written down and the same for everyone	Routing: operations, WCs, standards; files — drawing, versioned CNC program, setup sheet; control plan
5S	Workplace order: sort, set in order, shine, standardize, sustain	Outside the software but reflected in it: fewer “searching for a tool” pauses, higher OEE
Visual management	The state of the shop is clear at a glance	The board and “TV mode” on a screen in the shop, status colors, time standards green/yellow/red
Gemba (genchi genbutsu)	“Go and see”: decisions are made on the spot, not in the office	The board shows where to go: a problem, downtime, an overdue order. The foreman goes to the machine instead of calling
5 whys	Ask “why?” five times to reach the root cause	When closing a problem or a defect report, record the cause found and the fix, not just “resolved”
Kaizen and PDCA	Continuous small improvements in a plan — do — check — act cycle	Weekly: “Weekly summary” and the loss Pareto → choose one cause → act → check a week later with the same reports → lock it into the routing or reference data

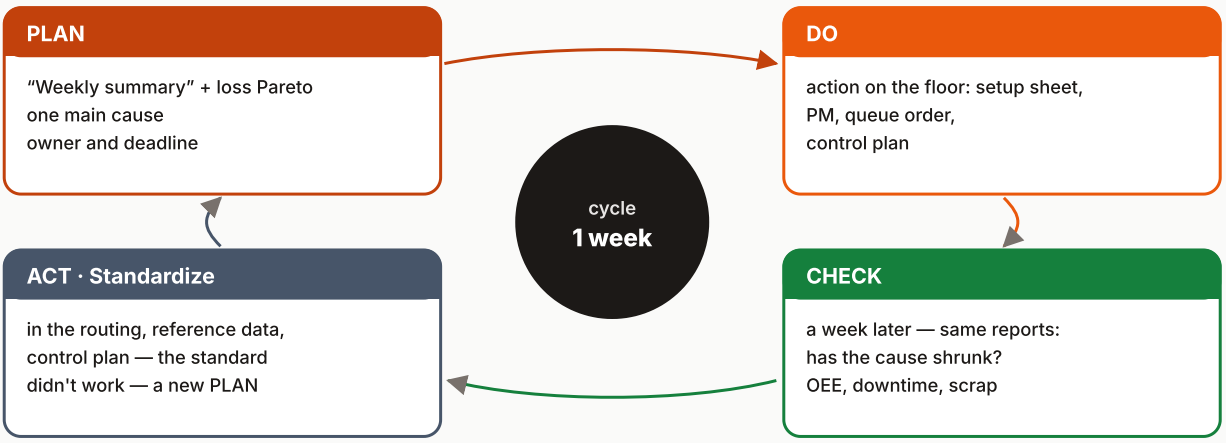


Diagram 7. The PDCA improvement cycle on a weekly rhythm

Toyota's 14 principles in brief — and what they mean for you

1. **Base decisions on the long term**, even at the expense of short-term gain: the system pays off not in the first week.
2. **Continuous flow** brings problems to the surface: fewer batches "waiting", more visible in WC queues.
3. **Pull** instead of overproduction: orders come from customer demand.
4. **Level the load:** "Capacity load", no month-end rush.
5. **Stop to fix problems** to get quality right the first time: "Problem" and defects stop work.
6. **Standards are the basis of improvement:** the routing and standards, not "the way I'm used to".
7. **Visual control:** the board, TV mode, hide nothing.
8. **Reliable, proven technology:** CNC programs via Tech prep and versioned, not "from a USB stick".
9. **Grow leaders who know the work:** the foreman runs the queue himself and spends time at the machines.
10. **Develop people and teams:** operators see their output and standards; their suggestions are discussed.
11. **Respect suppliers and partners:** purchasing for real demand and on time, without rushes.
12. **Go and see for yourself:** the software shows where the problem is; it is solved at the machine.
13. **Decide slowly and together, implement quickly:** changes to routings and standards come after analysis and apply at once to all new orders.
14. **Keep learning:** weekly review of losses and defects, small improvements every week.

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How to organize production with the software: step-by-step rollout

It is best to start with one section and expand once everything works there. Below is a proven sequence of about two months.

Period	What to do	Result
Week 1	Admin panel → “First run”: company, work centers with rates and seats, calendar and shifts, users with badges and PINs. Choose a pilot section	Everyone can sign in; machines and shifts are described
Weeks 1–2	Routings for the 20% of parts that make up 80% of the load: operations in steps of 005, WC, run, setup, lead time, consumption rates, drawing and CNC program	Orders can be started with standards and dates
Week 2	Reason catalogs: downtime, defects, problems — short and clear. Train operators: shift, “My tasks”, setup, start, pause, hand-in (30 minutes at the machine)	Operators record events themselves
Week 3	Orders via specifications; route sheets with QR travel with the parts. The foreman runs the WC queue. A daily stand-up at the board	The shop works in the software; paper logs are no longer needed
Week 4	Warehouse: acceptance, kitting, shipment. Tech prep: CNC programs via the library. Purchasing from “Requirements”	The cycle from order to shipment is closed
Month 2	Turn on Quality (control plan for critical parts), Maintenance (PM for key machines). First loss reviews: downtime and defect Pareto, bottleneck OEE	You can see where time goes — improvements begin
Then	Roll out to all sections. Revise standards based on actuals. A weekly improvement cycle	The system sustains itself

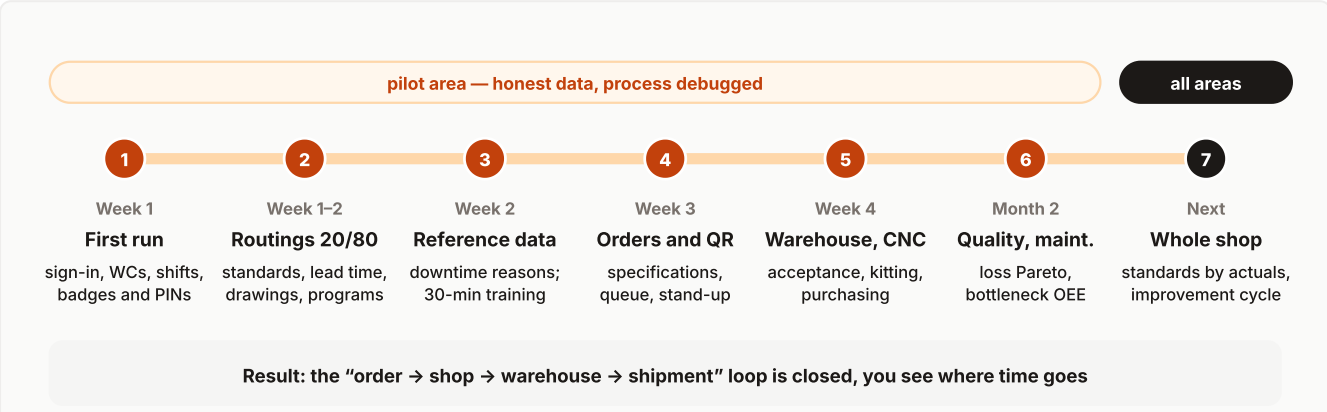


Diagram 8. Rollout in two months: a pilot area first, then the whole shop

The main rollout mistake is trying to set up everything for everyone at once. One section with honest data is more useful than ten where data is entered “for show”.

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Management rhythm: day, week, month

Lean manufacturing rests on regularity: short reviews at the same time using the same figures.

When	Who	What to look at in the software	Decision
Daily, start of shift, 10–15 minutes	Foreman, process engineer, storekeeper	Board: “Needs attention”, overdue, starting today; WC queues; readiness of CNC programs and material	The order of work for the shift, who clears which problems
During the shift	Foreman	Problems and breakdowns (Telegram), long pauses, hand-ins below the task	Clear the problem at the machine, decide “finish later or close at N”
End of shift	Foreman	Shift handovers, unclosed shifts and operations, time standards control	Put the data in order
Weekly, 30–45 minutes	Production manager, foremen, process engineer, QC	“Weekly summary”: on-time delivery, output, OEE, downtime and defects by reason; “Capacity load” for 4–8 weeks	One or two main loss causes → owner and deadline; leveling the load
Monthly	Management	OEE by WC, cost and output, maintenance (MTBF/MTTR), orders report	Revising standards, PM, staffing, investment in the bottleneck



Diagram 9. Management rhythm: what to look at and what decision to make

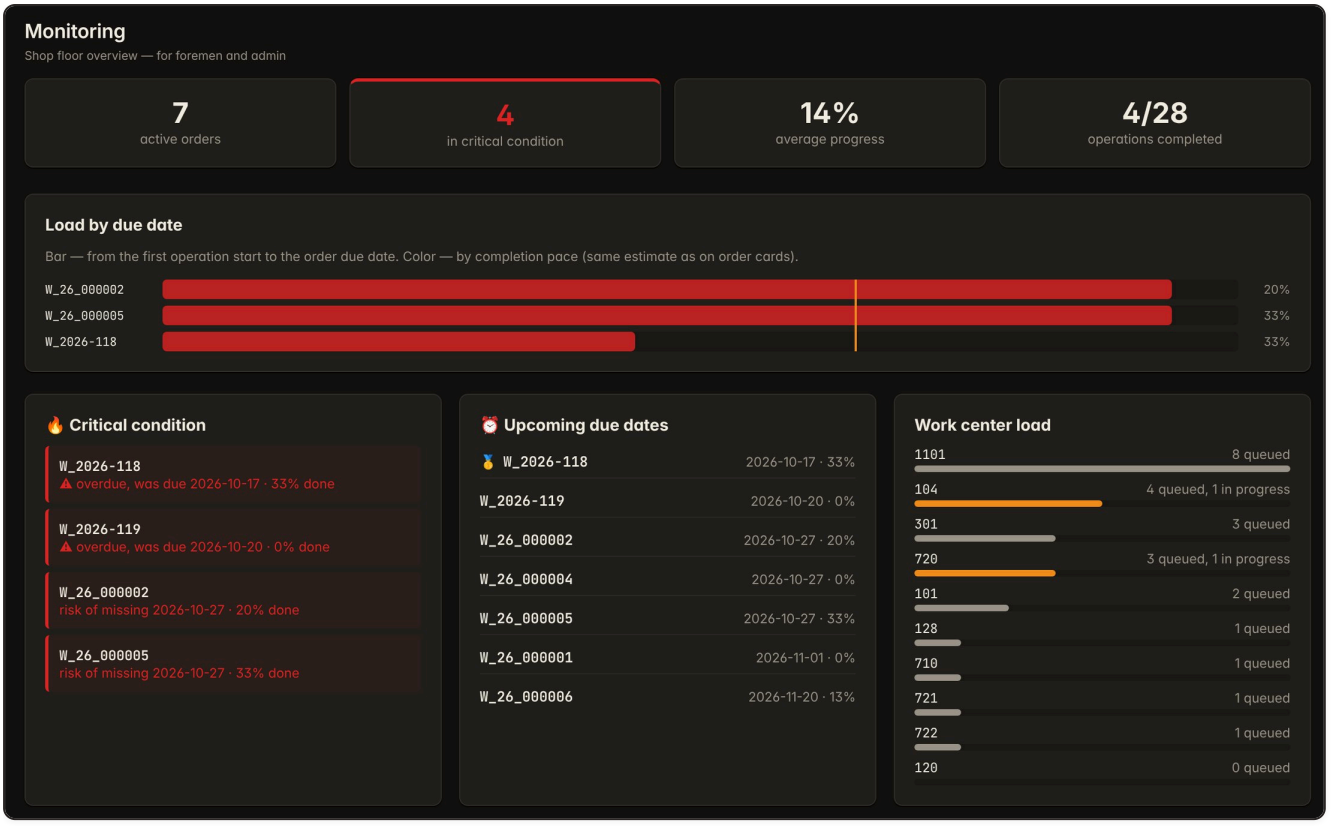


Fig. 57. Monitoring: orders by due date, critical state, WC load — for the daily stand-up

Metrics worth managing by

Metric	What it shows	Where in the software	Target
On-time delivery	Share of orders shipped on time	"Weekly summary", orders report	Grows month to month; goal — above 95%
Work center OEE	Availability × performance × quality	Reports → "OEE by WC"	Green — from 75%; the bottleneck first
Actual vs standard	Real time relative to the standard	Board → "Time standards"	100–115% — normal, above — review
Downtime by reason	Where time goes	"Analytics → Losses (Pareto)", "Weekly summary"	The main cause shrinks every week
Defects	Share and causes of defects	Defect reports, Quality, Pareto by part	First part inspected, repeated defects — a 5 whys review
Order lead time	From start to shipment	Orders report, "Capacity load"	Falls together with WIP
Work in progress	How many orders are "In progress" at once	Orders → "In progress", WC queues	No more than the shop really makes

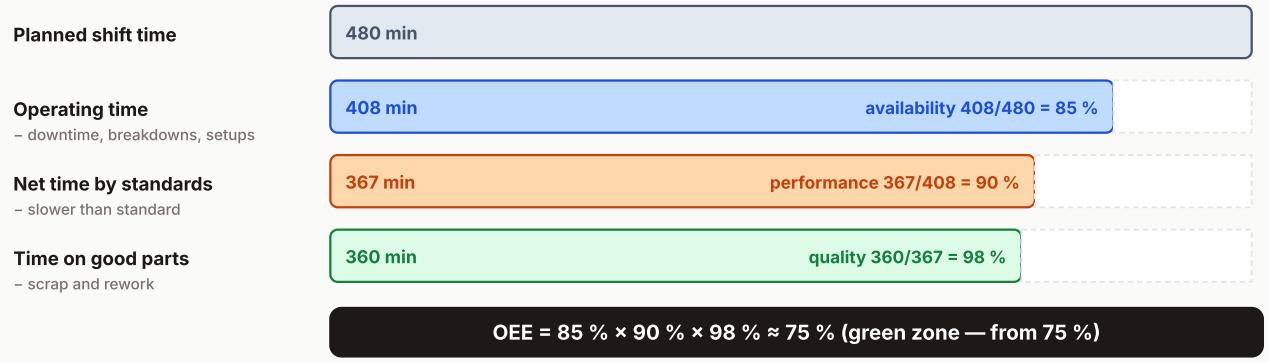


Diagram 10. What OEE is made of: three kinds of time loss (example shift of 480 min)

27 EVERYONE

Golden rules and common mistakes

10 golden rules

1. First the **item master and routing**, then the specification, then the order. Not the other way round.
2. One part — one card. The system won't let you create duplicate codes. If it refuses, look for the existing card instead of changing a letter.
3. Time standards and consumption rates are filled in **before** the start. Without them there is no plan, no requirements and no pay.
4. An order is started when programs are ready and material is reserved.
5. The route sheet with QR codes **travels with the parts**.
6. The operator records setup, start, pause and hand-in **at the moment of the event**.
7. Every pause, problem and defect — **with a reason**.
8. “Close at N” — only when it is certain nothing more will be made. Otherwise — “Hand in part”.
9. The foreman manages the queue instead of handing out tasks verbally.
10. Only what has been accepted into the warehouse is shipped.

Common mistakes

Mistake	Why it's bad	The right way
The operator records everything at the end of the shift	Actual Setup/Run is fake, the board lies	Record immediately
Forgot to pause	Lunch and downtime count as work	Pause with a reason
The order was created before the routing	The order has no operations or no standards	Routing first
A new card was created instead of using the existing one	History and programs drift apart	Find and fix the existing one
“Close at N” instead of “Hand in part”	The order shrank; there won't be enough parts to ship	If in doubt, hand in part
Material issued not against an order	No lot traceability, stock doesn't add up	Issue by order
One login for several operators	Output and pay are wrong	Everyone has their own badge and PIN
The shift wasn't closed	Time runs until morning	“End shift”; the foreman checks at the end of the day

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End-to-end example: a gearbox from customer order to shipment

One order from start to finish — to see how the steps from the first part add up to real work. The customer Agromash LLC ordered **6 RM-100 gearboxes** to be shipped on **31 October**.

1. Item master (process engineer, in advance)

Gearbox MX-01.000 is an assembly of four items. Each item has a routing:

Item	Per 1 gearbox	Lead time, days	Operations (WC · Run / Setup, min)
Gearbox MX-01.000 (assembly)	—	5	005 Bench work 40 / 20 · 010 QC 15 / 0
Drive shaft MX-01.002	1	7	005 Blanking 4 / 10 · 010 CNC lathe 18 / 45 · 015 CNC milling 12 / 40 · 020 Heat treatment 6 / 20 · 025 QC 5 / 0
Bushing MX-01.003	2	5	005 Blanking 2 / 10 · 010 CNC lathe 9 / 30 · 015 QC 3 / 0
Gearbox housing MX-01.001	1	10	005 Blanking 8 / 15 · 010 Fanuc milling 55 / 90 · 015 Bench work 15 / 10 · 020 QC 10 / 0
Bearing cover MX-01.004	2	4	005 Blanking 3 / 10 · 010 Universal lathe 14 / 25 · 015 QC 3 / 0

2. Specification and dates (foreman)

The foreman creates the specification “RM-100 gearboxes, batch 1”, adds the gearbox, quantity 6, due 31.10. The software expands the structure, multiplies the quantities and calculates dates **backwards from the due date**: start = due − lead time, and a part's due date = the start day of the assembly it belongs to.

Item	Quantity	Due	Start	How it is calculated
Gearbox	6	31.10	26.10	31.10 − 5 days
Shaft	6 × 1 = 6	26.10	19.10	due = assembly start; 26.10 − 7
Bushing	6 × 2 = 12	26.10	21.10	26.10 − 5
Housing	6 × 1 = 6	26.10	16.10	26.10 − 10
Cover	6 × 2 = 12	26.10	22.10	26.10 − 4

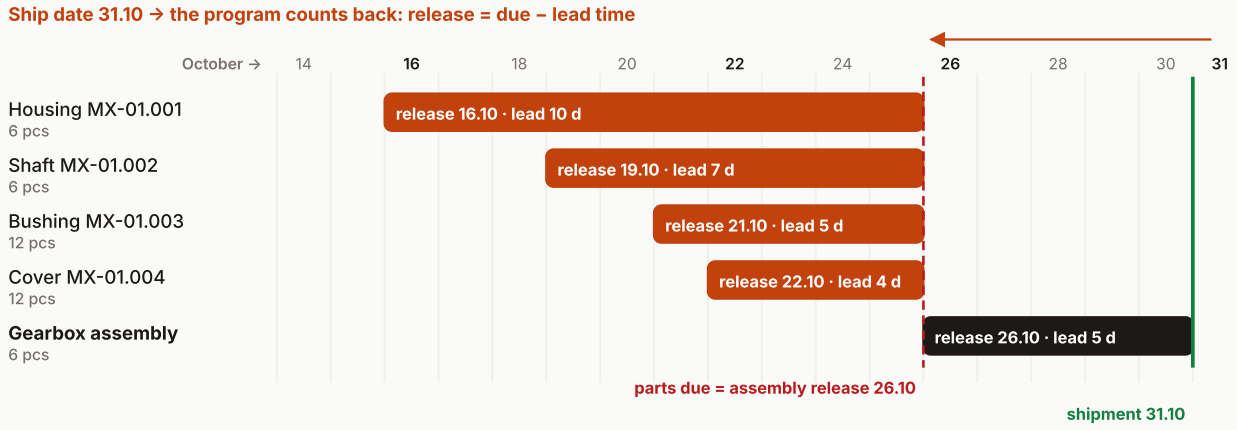


Diagram 11. Backward scheduling: release dates from the ship date

Specification status “In production” → “Create all orders”: five W_... orders appear, each with its own operations and QR codes. You can see that **the housing must start first** — on 16 October — even though shipment is only at the end of the month. This backward scheduling is exactly what protects the due date.

The labor, for example, for the shaft: Total = ΣSetup + ΣRun × quantity = (10 + 45 + 40 + 20 + 0) + (4 + 18 + 12 + 6 + 5) × 6 = 115 + 270 = **385 min ≈ 6 h 25 min**. The software shows this figure in the order card and takes it into account in capacity load.

3. Preparation (CNC programmer, storekeeper)

- Tech prep → “By order”: the shaft has no programs for operations 010 and 015, the housing — for 010. The programmer takes them into work and uploads the CNC programs before the start dates.
- Warehouse → “Requirements”: there isn't enough 30 mm plate for the housing → “Order” → a purchase; on receipt the lot (heat) is entered. Until the plate arrives, the housing order is in “Waiting for material”, not “In progress”.

4. Shop floor (operators, foreman)

- On 19.10 the CNC lathe operator scanned the QR of shaft operation 010: “Setup” (actual setup), then “Start”.
- By the end of the shift 4 of 6 were done → “Hand in part”: the operation stays open, and the relief finishes the remaining 2 in the morning (shift handover with a comment about the setup).
- On milling operation 015 one part was rejected: dimension out of tolerance. The operator hands in 5 good and 1 defective with a photo — a report is created; the foreman decides: the part can't be fixed and there are no more blanks. The foreman chooses **“Close at 5 pcs”** — the shaft continues along the route with a quantity of 5, and a separate order is created for the missing shaft (or a one-off “New order” for 1 pc).
- QC checks the first part per the control plan (dimension Ø40h7 — micrometer, every 5th), and the measurements are linked to the order and the material lot.

5. Warehouse and assembly (storekeeper)

- The last operation is closed — the parts appear in “Awaiting acceptance” by themselves. The storekeeper counts and accepts them.
- Kitting: the structure card shows how many kits can be assembled — with 5 of 6 shafts, 5 gearboxes are assembled. Assembly doesn't start until the order is kitted (if “Assembly only after kitting” is on).
- The sixth shaft arrives later — it is kitted, assembled, and the sixth gearbox is accepted.

6. Shipment and outcome

Shipment against the specification — 6 gearboxes; the specification and orders go to the archive. The “Orders report” shows that the shaft ran over standard on the milling operation, and “Losses (Pareto)” shows “Waiting for material” downtime on the housing. These are two topics for the next weekly meeting.

Six gearboxes shipped. Bruno checked the boxes — from the inside, as cats do. 

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What to do if...

Situation	Who	What to do in the software
A machine broke down mid-batch	Operator, foreman	Operator: “Hand in part” for what is done, then “Breakdown” — the request goes to Maintenance and the machine is marked down. Foreman: moves the unclosed operations to another work center (✎ on the operation in the order card) or waits for the repair
A defect on the last operation	Operator, QC, foreman	The operator hands in good and defective parts with a reason and photo — a report is created. Foreman: a fixable defect — return the operation to work (rework); unfixable — close at the good quantity and create an order for the missing parts
The customer moved the due date	Foreman	Change the ship date in the specification — the start and due dates of all its orders are recalculated automatically
The customer reduced or increased the quantity	Foreman	Correct the quantity in the specification. In an existing order the quantity can be changed while operations are not closed; if work is already under way — “Close at N” or an additional order
More was made than needed	Storekeeper	Surplus parts arrive at the product warehouse as a normal receipt — accept them. The warehouse is shared: they will go into the next order's kit. The cause of overproduction — to the meeting
An urgent order out of turn	Foreman	Priority “High” and drag the operations to the top of the WC queue. Check in “Capacity load” whose dates will shift because of it, and warn them
An operation is needed that isn't in the routing	Foreman	In the order card add an operation (at the top, in between or at the end) — for this order only. If it will always be so — the process engineer edits the routing
The part must be made on another machine	Foreman	✎ on an unclosed operation → another work center. Closed operations don't change
No CNC program or drawing	Operator, process engineer	Operator: “Problem” with a reason. Process engineer: Tech prep → program → “Done”. The foreman clears the problem
No material	Storekeeper, foreman	Order — status “Waiting for material”. Warehouse → Requirements → “Order”. On receipt enter the lot and reserve it for the order
The QR code doesn't scan	Operator	Scanner → “By order number” (the number from the route sheet) or “Manual entry” of the operation code. A crumpled sheet — reprint it from the order card
The order was cancelled halfway	Foreman, storekeeper	Status “Cancelled”. Book what was made into the product warehouse, release the material reservation. Record the reason in the comment

Situation	Who	What to do in the software
An operator forgot to close a shift or an operation	Foreman	Close the forgotten shift (Admin panel → Shifts → open shifts) and sort out the operation: hand in part or return it to the queue. Don't use the actual time of such an operation when revising standards
A badge is lost	Administrator	Admin panel → Users → 🪪 → "Reissue": the old code stops working immediately
A person can't sign in	Administrator	Admin panel → Security → "Failed sign-ins" → find by email: the "Reason" column shows what's wrong. Forgot the password — "Reset password" (a 24-hour link). Hit the limit — "Remove lock"
No connection to the server	Everyone	The software retries the request itself. If it fails: write the time and quantity on the route sheet and enter them right after the connection is back; the foreman notes this in the order comment
The cat lay down on the keyboard or the route sheet	Anyone	Pet the cat — it came for attention. Then check what got typed into the fields before pressing "Hand in": cats like the 0 key, pressed many times. Bruno would approve of step one

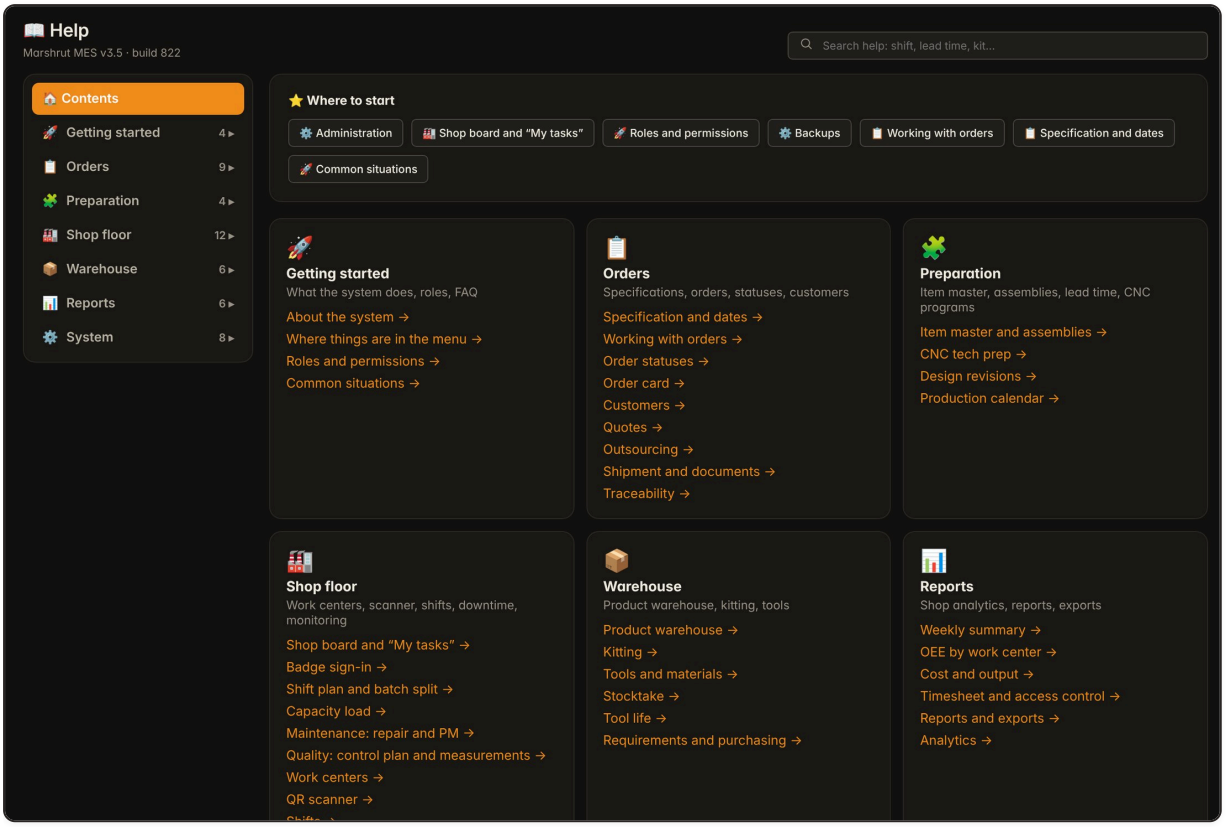


Fig. 58. In-app help: the same situations with explanations — the "Help" button in the menu

30 ENGINEER · FOREMAN

Time standards and reference data: how to set them right

Due dates, capacity load, cost and pay depend on the standards, and all loss analytics depend on the reason catalogs. It is worth doing carefully once.

Where to get initial standards

Method	When it fits	How
By analogy	A new part resembles a familiar one	Take the run and setup time of a similar operation and adjust for the difference (machining length, number of steps)
By calculation	CNC operations	Run — the program cycle time plus loading and unloading the part; Setup — the setup time per the setup sheet
Time study	Manual and bench operations	Time 5–10 cycles of an experienced operator, take the average without obvious outliers, add 10–15% for rest and workplace upkeep
From the first batches	No analog and no calculation	Set an approximate standard, after 2–3 batches take the actual time from time standards control

How to maintain standards

- Actual vs standard is shown in time standards control. Green — on standard, yellow — up to 15% over, red — more than 15% (thresholds — Admin panel → Maintenance).
- Revise a standard if the deviation **persists** for 3 or more batches in a row, not because of a single case. Check downtime first: an operation's actual time in time standards control is the time from “Start” to “Hand in” including pauses, so long pauses on that operation must be separated out (they are visible in the pause history and the downtime report).
- Only the process engineer edits a standard — in the routing. New orders take the new standard; existing ones stay as they were.
- A standard “with a margin” is as harmful as an understated one: it hides losses and inflates capacity load.

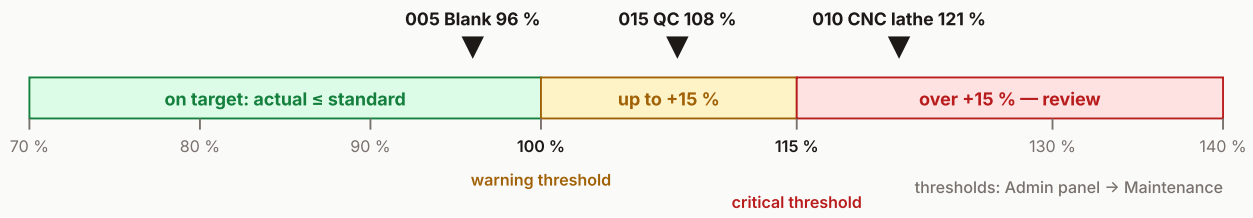


Diagram 12. Time standards control: operation color by the actual-to-standard ratio (example order W_26_000003)

Reason catalogs

Reasons are set in Admin panel → Reference data. A good catalog has **6–10 reasons**, clear to the operator without explanation and pointing to who must act. “Other” should be under 10% — if more, a reason is missing from the catalog.

Downtime reasons (example)	Who resolves it
Lunch, break	— (planned)
Waiting for material / blank	Storekeeper, purchasing
No CNC program / drawing	Process engineer
Waiting for QC	QC
Setup took too long / no fixture	Foreman, tool room
Equipment breakdown	Maintenance
Waiting for the foreman's decision	Foreman
Other (with a comment)	Reviewed at the meeting

Defect reasons (example)	Typical root cause
Dimension out of tolerance	Tool wear, setup, temperature
Surface roughness not met	Cutting conditions, tool
Dents, damage	Handling, containers
Blank / material defect	Supplier, incoming inspection
CNC program error	Tech prep, first-part check
Error in the drawing / routing	Designer, process engineer

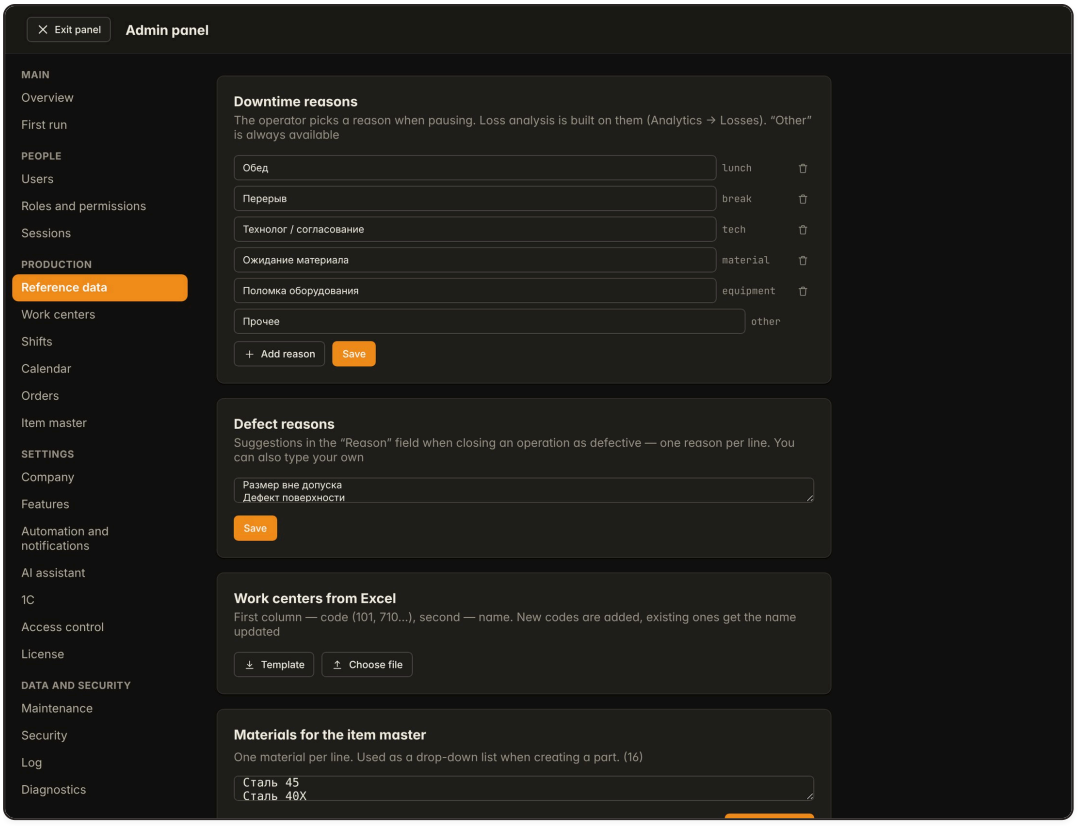


Fig. 59. Admin panel → "Reference data": downtime and defect reasons — short and clear to the operator

31 MANAGER · FOREMAN

Capacity and takt calculation by example

Available time of a work center

The software calculates it from the calendar, shifts, seats per WC and the utilization factor. For example, a CNC lathe (1 machine):

What	Value	Where in the software
Working days per month	21	Admin panel → Calendar
Shifts per day × hours per shift	2 × 7.5 h (8 h minus lunch)	Admin panel → Shifts
Seats on the work center	1	Work centers → seats
Calendar capacity	21 × 15 = **315 h**	
Utilization factor	85% (setups, minor stops)	Set in “Capacity load”
Available for orders	315 × 0.85 ≈ **268 h**	

Demand and load

The customer takes **120 gearboxes a month** in batches of 30 (4 batches). The CNC lathe gets the shaft (1 per gearbox) and the bushing (2 per gearbox):

Part	Pcs per month	Run × pcs	Setup × batches	Total
Shaft, op. 010	120	18 × 120 = 2160 min	45 × 4 = 180 min	39 h
Bushing, op. 010	240	9 × 240 = 2160 min	30 × 4 = 120 min	38 h
Total				**77 h of 268 h ≈ 29%**

Every WC is calculated the same way — the software does it automatically in “Capacity load” from real orders. The bottleneck is the WC with the highest percentage; if it is above 100% in some week, that week's due dates can't be met without moving work, a second shift or outsourcing.



Diagram 13. Available time of a machine and its load by orders

Takt

Takt = available time ÷ customer demand. For the shop: 21 days × 15 h × 60 = 18,900 min a month ÷ 120 gearboxes = **157.5 min per gearbox**. So the shop must turn out one gearbox roughly every 2.5 hours.

Compare takt with the bottleneck's time per gearbox. Fanuc milling (housing): 55 min + 90 / 30 for setup ≈ 58 min — fits into takt with a margin. If the bottleneck's time per product were longer than takt, even output would be impossible: you would need to cut run or setup time, level the batches or add capacity.

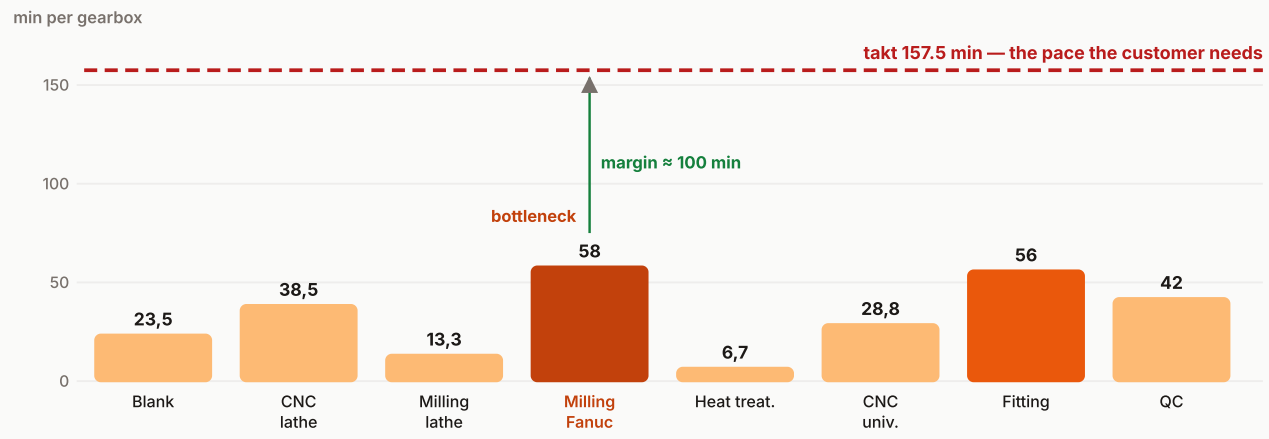


Diagram 14. Time per gearbox by work center and takt: the bottleneck is the Fanuc milling machine

> The software doesn't calculate takt — it is calculated with this formula once when planning the month or when demand changes. Available time comes from the calendar and shifts, demand — from specifications.

32 FOREMAN · MANAGER

Templates for meetings and reviews

Daily stand-up at the board — 15 minutes

Minutes	Question	Where in the software
0–3	What happened on the last shift: problems, breakdowns, defects	Board → “Needs attention”, defect reports, Maintenance
3–7	What is urgent: overdue, starting today, missing CNC programs and material	Board, Orders, Tech prep, Warehouse → Requirements
7–12	The order of work for the shift around the bottlenecks	WC queue, “Capacity load”
12–15	Who clears what and by when	Problem comment: owner and deadline

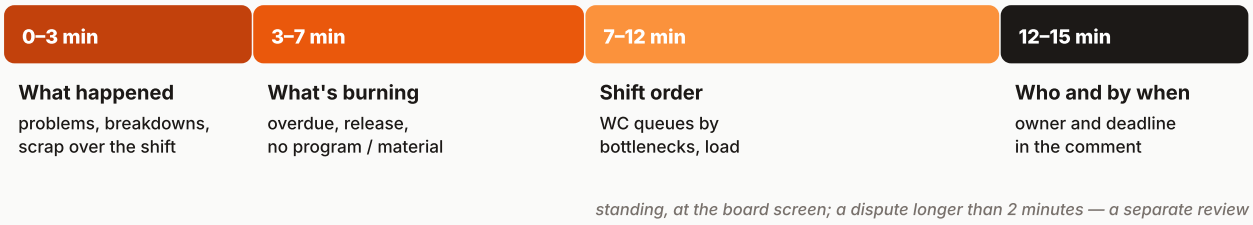


Diagram 15. Daily stand-up — 15 minutes following one script

Rules: standing, at the screen with the board, no discussion of solutions longer than 2 minutes — long questions go to a separate review.

“5 whys” problem review

Field	Example
What happened (facts, figures)	3 shafts of 6 — dimension Ø40h7 is 0.03 mm over, op. 015
Why 1	The cutting tool is worn
Why 2	It ran longer than its tool life
Why 3	Tool life is not tracked
Why 4	There is no replacement rule in the setup sheet
Why 5 (root cause)	The setup sheet doesn't include a tool change interval
Measure and owner	The process engineer adds the tool life to the setup sheet by Friday; QC — measure every 5th part
Check (a week later)	Defects for this reason in “Losses (Pareto)” — 0

Field	Example
Lock in	Setup sheet in the operation files, control plan

The cause and measure found are written in the comment when closing the problem or defect report, so the next review doesn't start from zero.

Weekly data check — foreman's checklist

- No operations “In progress” for more than two shifts without a hand-in.
- No unclosed shifts or unclosed pauses.
- Every problem has a comment about the cause and the fix.
- The share of “Other” in downtime is under 10%.
- All warehouse receipts are accepted, no discrepancies.
- No red operations in time standards control without an explanation.
- Orders “In progress” are really in progress; the rest are “Planned” or “Waiting...”.

Baseline metrics before rollout

Fill in before starting to work in the software — in a month there will be something to compare with.

Metric	Before rollout	After 1 month	After 3 months
Orders on time, %			
Average order lead time, days			
Orders in progress at once			
Defects, % of output			
Hours per week compiling reports by hand			
Bottleneck OEE, %	— (not measured)		

33 EVERYONE

Glossary

Term	Meaning
WC (work center)	A machine or section where an operation is performed. A WC has a code, rates and a number of seats
Item master	The catalog of parts and assemblies with routings
Routing	A part's list of operations: number, WC, time standards, files
Specification (SP-)	A customer order for a product: structure, quantity, ship date
Order (W_)	A production assignment for one part or assembly in the required quantity
Route sheet	The order's printed sheet with a QR code for each operation; travels with the parts
Run time	The time standard per part, min
Setup time	Setup time per batch, min; doesn't depend on the quantity
Total time	The order's total time: ΣSetup + ΣRun × quantity
Quote	A commercial offer: price from the routing and lead time from the load, before an order exists
Outsourcing	An operation performed by an external supplier; sending and receiving are recorded in the software
Design revision, change notice	A version of the drawing and routing; the notice records what changed and requires a decision on open orders
Alternative WC	A machine on which the routing also allows the operation; offered first when moving work
Tool life	How many parts or cutting minutes a tool works before replacement
Lead time	The production cycle: how many calendar days from start to completion of an item
CNC program	The control program for a CNC machine
WIP	Parts and orders that are started but not yet finished
Time standards control	Comparing the actual time of operations with the standard
OEE	Overall equipment effectiveness: availability × performance × quality
PM	Planned preventive maintenance on a schedule
MTBF / MTTR	Mean time between failures / mean time to repair
Takt	The output rhythm the customer needs: available time ÷ demand
Bottleneck	The most loaded WC; it determines the output of the whole shop

Term	Meaning
Andon	A problem signal everyone sees at once (the “Problem” and “Breakdown” buttons)
Poka-yoke	Error proofing: the system doesn't allow a wrong action
Kaizen	Continuous small improvements
Pareto (80/20)	A few causes make up most of the losses — start with them
Traceability	By order or lot you see who made the part, where, from what and with which measurements
Sniper *(unofficial)*	An operator who hands in right on the standard, every time. Named after Bruno the cat, who always hit the bowl (last page)

34 OPERATOR

Operator quick guide

The main rule: press the button at the moment it happens.



Diagram 16. Eight presses per shift — at the moment of the event

Start of shift

1. Sign in: “By badge” tab → scan your card → PIN.
2. “Start shift” → choose your machine (work center).
3. “My tasks” — work through them from top to bottom. Only the foreman changes the order.

Work

1. Scan the **operation QR code** on the route sheet (or find the task in the list).
2. 🔧 **Setup** — you started setting up the machine. ✔ **Setup done** — you finished.
3. ▶ **Start** — the first part is running.
4. ▮ **Pause** — you stepped away or the machine is idle. **Always choose a reason.**
5. ✔ **Hand in** — enter good parts and scrap.

Handed in less than the task

- **Hand in part** — the rest will be finished later by you or your relief. *Choose this if in doubt.*
- **Close at N pcs** — no more will be made. Only by the foreman's decision.

If something is wrong

What happened	Press
No material, program or drawing; a question about the part	**Problem** + reason
The machine broke down	**Breakdown**
A part is defective	When handing in — scrap, reason, **photo**
The QR code won't scan	Scanner → “By order number” or “Manual entry”
Can't sign in	Check the keyboard layout and Caps Lock; otherwise see the foreman

> “Start” won't press? The program shows the reason: no open shift, the order isn't released or is in “Problem”, the previous operation isn't closed or is scrapped. This is a safeguard, not a failure.

End of shift

1. **Don't close** an unfinished operation — use “Hand in part”.
2. **Hand over shift** — briefly: setup, tooling, batch status.
3. **End shift.**

Never give your badge or PIN to anyone: your output is counted by them.

35 FOREMAN

Foreman quick guide

The foreman runs the queue and removes problems. Tasks are not handed out verbally — only through the queue.

Morning, before the shift (10–15 minutes at the board)

1. Board → “Needs attention”: problems, breakdowns, defects.
2. Overdue orders and “Starting today”. Are the CNC programs ready (Tech prep) and the material (Warehouse → Requirements)?
3. The queue of each work center: reorder by dragging, urgent work to the top.
4. “Capacity load”: overloaded work centers → move operations (✎ on the operation → another work center).

During the shift

Signal	What to do
“Problem” on an order	Go to the machine, solve it, clear the problem **with a comment: cause and solution**
“Breakdown”	Maintenance has received a request; move operations to another work center or wait
Handed in less than the task	Decide: finish later (“Hand in part”) or “Close at N”
Defect	Decide by the defect report: rework or write-off; the shortfall — as a new order
An extra operation is needed	Order card → add an operation (at the start, in between, ✎)
Urgent order	Priority “High”, operations to the top of the queue

End of shift

- Read the shift handovers. No “hanging” operations or unclosed shifts (Admin panel → Shifts).
- Time standards control: red operations — find out why.

Once a week

“Weekly summary” + “Losses (Pareto)” → one main cause of losses → owner and deadline → check a week later.

> Actual time is always worse than the standard? Don't adjust the records — ask the process engineer to revise the standard.

36 STOREKEEPER

Storekeeper quick guide

Materials

1. **Warehouse → Requirements**: what is missing for released orders → “Order”.
2. Purchase: draft → sent → **receipt**. On receipt always enter the **lot** (heat, certificate).
3. **Reserve** for an order — so the material isn't taken for another one.
4. Issue to the shop — **per order**, not “to the section”.

Products

1. When the last operation is closed, parts appear in **“Awaiting acceptance”** automatically. Receipts are not created by hand.
2. **Acceptance**: count and confirm the actual quantity. Doesn't match what was handed in — see the foreman, don't “accept as is”.
3. **Kitting**: enter the order or specification number → you see what is available. A completed kit writes the parts off the warehouse. Assembly won't start until the order is kitted.
4. **Shipment** — by specification and only what is in the warehouse.

If something is wrong

What happened	What to do
More arrived than needed	Accept — the surplus goes to the next kit; tell the foreman
Less arrived	Don't accept blindly — check with the foreman
Material arrived without documents	Accept with a note, get the lot from the supplier — no lot, no traceability
The order was cancelled	Finished parts — to the warehouse, release the material reserve

Stock must match the shelves. Once a month — a material stocktake.

37 PROCESS ENGINEER

Process engineer quick guide

Items and routing — before the order

1. The **code** is unique: the program won't let you create a duplicate (including Latin/Cyrillic look-alikes, case, spaces) — look for the existing card.
2. **Operations** in steps of 5 (005, 010, 015…): choose the work center first — the name fills in automatically.
3. **Run time** — per part, **setup time** — per batch. Zeros in the standards break due dates, capacity load and pay.
4. **Lead time** — days from release to completion: release dates are calculated from it.
5. **Material consumption rates** — without them there are no requirements or purchases.
6. **CNC** — a checkbox on the operation; **files** — drawing, CNC program (versions), setup sheet. The operator sees the latest version at the machine.

Time standards

- Initial: by analogy, by calculation (program cycle + loading), by time study (5–10 cycles + 10–15 %), or from the actuals of the first batches.
- Revise when the deviation in time standards control is **steady for 3 batches or more**. New orders will take the new standard.

Tech prep (CNC programmer)

1. Tech prep → “By order”: which programs are missing and by when.
2. Take in work → upload the program (each upload is a new version) → “Done”.
3. A one-off request without an item → when the part appears, **link** the request to it.

Quality

- A control plan for critical parts: dimension, nominal, tolerance, instrument, frequency (first part, every N-th).
- A defect repeats — a “5 whys” analysis, the measure goes into the routing, the setup sheet or the control plan.

Bruno

2024 — 17 JULY 2026



Orange and white. No tail. The kindest heart.

A rescued cat who lived two happy years with us. Much of Marshrut MES was written with him purring nearby — and his pixel portrait now lives in the corner of the program, next to the version number. Click it.

At the shelter they called him “the Sniper”: he always hit the bowl dead centre. So do good operators — right on the standard.

If you have a pet — hug it today.

maximovskiy.tech/bruno